Concrete

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Concrete in Track Elevation Work Placed in Cold Weather

Warming the Concrete in Mixer Drums—Carried Long Distances With Gasoline-Driven Buggies—Oil-Burning Salamanders—Inclosing the Structure

By L. W. SKOV
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PLACING concrete during cold weather in a number of widely separated structures, some of plain concrete design, some of reinforced concrete, and some of concrete-incased steel, has been one of the problems of the engineering department of the Chicago, Burlington & Quincy Railroad for several winters.

The structures to which reference is made are in the vicinity of Sixteenth Street, Chicago, west of the Chicago River, which were required in connection with certain grade separation work.

Distribution With Gasoline-Driven Buggies

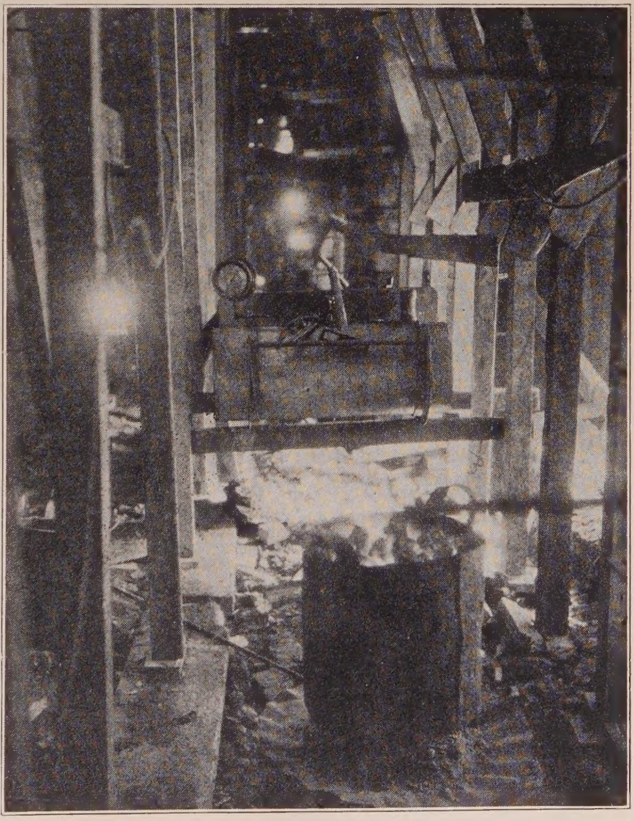
The greater part of the concrete for this work was supplied by three mixing plants placed in three of the more convenient locations, each equipped with a mixer having a capacity of ⅔ cu. yd., and each provided with facilities for heating the materials. Each mixer was also supplied with an oil-burning torch within the mixing drum.

Even with the three mixing plants located in the most advantageous positions, it was necessary to haul some concrete for distances as much as 2,000 ft. Faced with these conditions, it was decided to use 3-wheeled gasoline-driven concrete buggies to distribute the concrete in all cases except where the mixer was adjacent to the structure being concreted. On straight runways these buggies were able to travel 10 miles an hour, so that little of the heat in the freshly mixed concrete was lost between the mixer and the forms. The capacity of the buggies is about ¾ cu. yd.; but since the mixer batches contained only about ½ cu. yd., this was the amount of concrete carried by the buggies.

Viaduct Slab 4½ Ft. Thick

The construction of three spans of a railway track elevation structure that is owned jointly by four railways, and extends from Stewart Avenue to the river in the vicinity of Fifteenth Place, will serve well as an illustration of the methods employed in mixing, transporting and placing the concrete, and in protecting it from cold weather during the hardening period.

The spans in question are of very heavy construction and are the first three spans west of the river. The spans are 58 ft. from center to center of supports, and consist of concrete-incased steel girders about 4 ft. deep, spaced

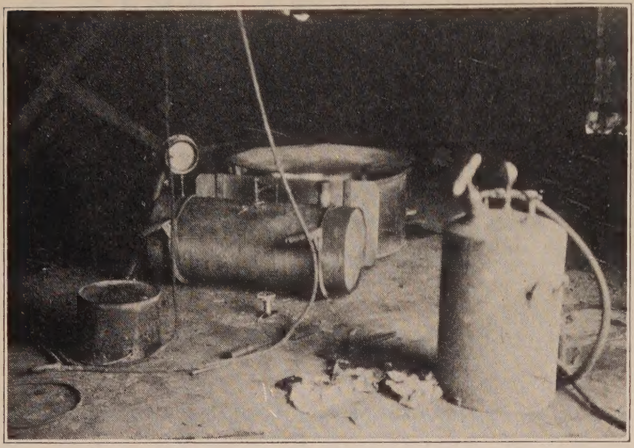


Within the inclosure. Coke salamander on ground, kerosene salamander above

3 ft. 6 in. from center to center. Because of the close spacing of the girders, estimates indicated that the cost of forming between them would exceed the cost of the additional concrete required to cast a solid slab. In consequence, a solid slab was concreted to a thickness of 4 ft. 6½ in., serving as incasement and lateral bracing for the steel girders and as support for the track ballast.

Make Long Hauls in Cold Weather

The three mixers previously mentioned, and now designated as Nos. 1, 2 and 3, were all employed in supplying concrete for this structure. The progress of the concreting operation, on a day when temperatures ranged from 8 to 20 deg. F. and 350 cu. yd. of concrete were placed, is well worth recording.



Close-up view of kerosene-burning salamander on top of slab

Mixer No. 1 was located between 1,500 and 2,000 ft. from the place where the concrete was deposited. At this mixer the sand, the crushed stone and the water were heated, resulting in concrete ranging in temperature from 70 to 75 deg. F. at the mixer. The gasoline-driven buggies previously mentioned transported the concrete from this mixer to a point about 300 ft. from the structure. Here the concrete was dumped into a drop-bottom hoisting hopper and was hoisted up to the deck of the viaduct, again dropped into a gasoline-driven buggy and transported to the place of deposit on a runway built for the purpose.

Oil Heaters in Mixing Drum

At mixer No. 2, located about 800 ft. from the structure, trouble was experienced on this particular day because of a strong northwest wind. The mixer faced west and was in an exposed location. Even with a kerosene "aeroil" heater installed in the mixing drum, some batches of concrete had temperatures as low as 38 deg. F. after 1½ minutes of mixing. In order to correct the trouble the discharge end of the mixer was covered with canvas to shut off the wind, thus permitting the torch flame to penetrate the entire length of the mixer drum. After this change was made, temperatures of about 55 deg. F. were obtained after 1½ minutes of mixing. This concrete, likewise, was transported to the place of deposit by 3-wheeled gasoline-driven buggies.

Mixer No. 3 was located adjacent to the three spans under construction. The discharge end of the mixer faced north, and due to special reasons it could not be covered with canvas. The general location of this mixer was less exposed than No. 2, so that by providing the drum with a kerosene heater and steam-heating the sand the temperature of the concrete was around 70 deg. F. after 1½ minutes of mixing.

Temperature of Concrete in Place

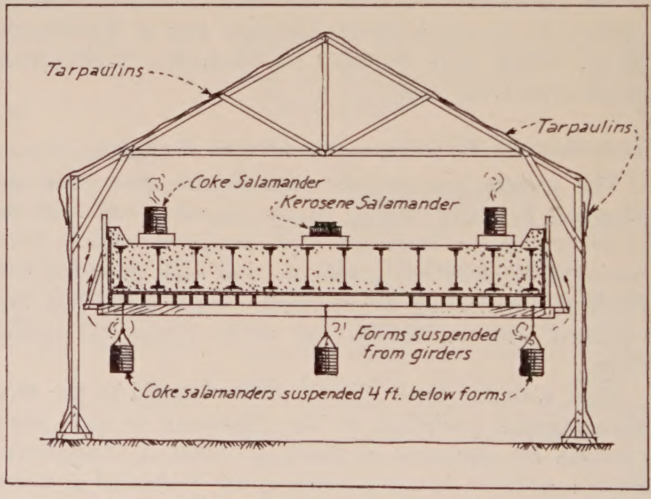
The temperature of the concrete in the forms was watched carefully, and numerous temperature readings were taken as check tests. These readings indicated satisfactory conditions, with temperatures ranging from 55 to 60 deg. F. High grade, quick-acting thermometers were used.

Trouble was encountered at first because of the tendency of the concrete to freeze to the steel girders, thereby preventing proper filling of the spaces below the bottom flanges. It was found necessary to heat the girders by keeping kerosene torches constantly playing upon them, in advance of concreting.

Protection During Curing Period

The protection provided to keep the air surrounding the structure at a temperature sufficiently high to permit proper hardening of the concrete is shown in the line drawing.

As indicated in this sketch, wooden frames supported on the form work were covered with tarpaulins. The frames were extended down the sides to the ground, and the sides were also covered with tarpaulins, completely inclosing the space below the slab. The canvas was held about 2 ft. away from the sides of the slab, so as to permit free circulation of air around the slab.


Tarpaulins
Tarpaulins
Coke Salamander
Kerosene Salamander
Forms suspended from girders
Coke salamanders suspended 4 ft. below forms

Layout of cold weather protection for railway track elevation structure

Number of Salamanders Required

Each span of the structure was completely inclosed as soon as the placing of concrete in that span was completed. These separate inclosures were, roughly, about 40 by 60 ft. in plan. In each inclosure there were 16 coke salamanders below the viaduct slab, suspended about 4 ft. below the forms. On top of the slab there were 6 coke salamanders, of which 3 were placed along each side. Also, above the slab, there were 2 kerosene-burning salamanders of the type shown in one of the illustrations.

These were set near the longitudinal center line of the structure, near the third-points of the span.

For several days following the completing of concreting, the temperature of the outside air was in the vicinity of zero F. During this time the temperature inside the inclosure was held at 50 deg. or higher, even on the side exposed to the wind. The weather then moderated and considerable rain fell, after which some of the fires were put out to avoid temperatures so high as to cause premature drying out.

The rainy weather now created favorable curing conditions, since a sufficient amount of rain leaked through the tarpaulins to keep the surface of the concrete well moistened.

Good Results With Vibrators

Very good results were obtained in this structure and others in the vicinity by the use of electric-driven vibrators, which greatly facilitated the puddling of the concrete around the steel girders. Dense concrete, free from honeycomb, was obtained throughout the structure. This, however, is another story the writer hopes to tell to readers of CONCRETE in a later article.

Acknowledgments

The design of this structure was prepared under the immediate supervision of the writer, who acted under the general direction of G. A. Wiegel, special engineer, and A. W. Newton, chief engineer, C. B. & Q. R. R. Co. The structure is owned jointly by the C. B. & Q., the B. & O. C. T., the C. & N. W. and the Pennsylvania railways. The resident engineer representing the owners was Joseph Richmond, of the C. B. & Q.

The general contractor was the W. J. Newman Company, of Chicago.

Estimating Cost of Concrete Work

Detailed Estimate for 5-Story Reinforced Concrete Garage Building—Illustrates Use of Methods Given in Previous Articles

V—Example of Typical Estimate

By LESLIE H. ALLEN
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THE estimate here given is based on a specific set of working plans for a building. The methods and figures should be studied in the light of the four previous articles printed under this heading, in the issues of June to September, inclusive, and more especially in the light of the writer's concluding remarks on page 22 of the September issue.

The building figured is a 5-story reinforced concrete garage in a large southern city, shown in the accompanying plans.

The floors are of metal pan construction and the exterior walls are of reinforced concrete cast integral with the columns.

Labor rates were as follow:

Carpenters, $1.12½ (or 75 per cent of $1.50, the figure used in the preceding articles).

Cement finishers, $1.50 per hr.

Steel was placed by negro labor at $0.30 with a carpenter boss at $1.12½, making the average rate for the gang $0.50 per hr.

Negro labor, $0.30 per hr.

Low priced negro labor is usually not so efficient as the higher priced white labor used in the North. Although the labor rate per hour is only 35 per cent of that used previously, the cost of work performed by common labor on this job was figured at 50 per cent of the former figures.

The computation of the principal unit costs was as follows:

Concrete labor per cubic yard—

Unloading cement	$0.04
Mixing concrete	.30
Placing concrete, footings	.75
Total labor	$1.09

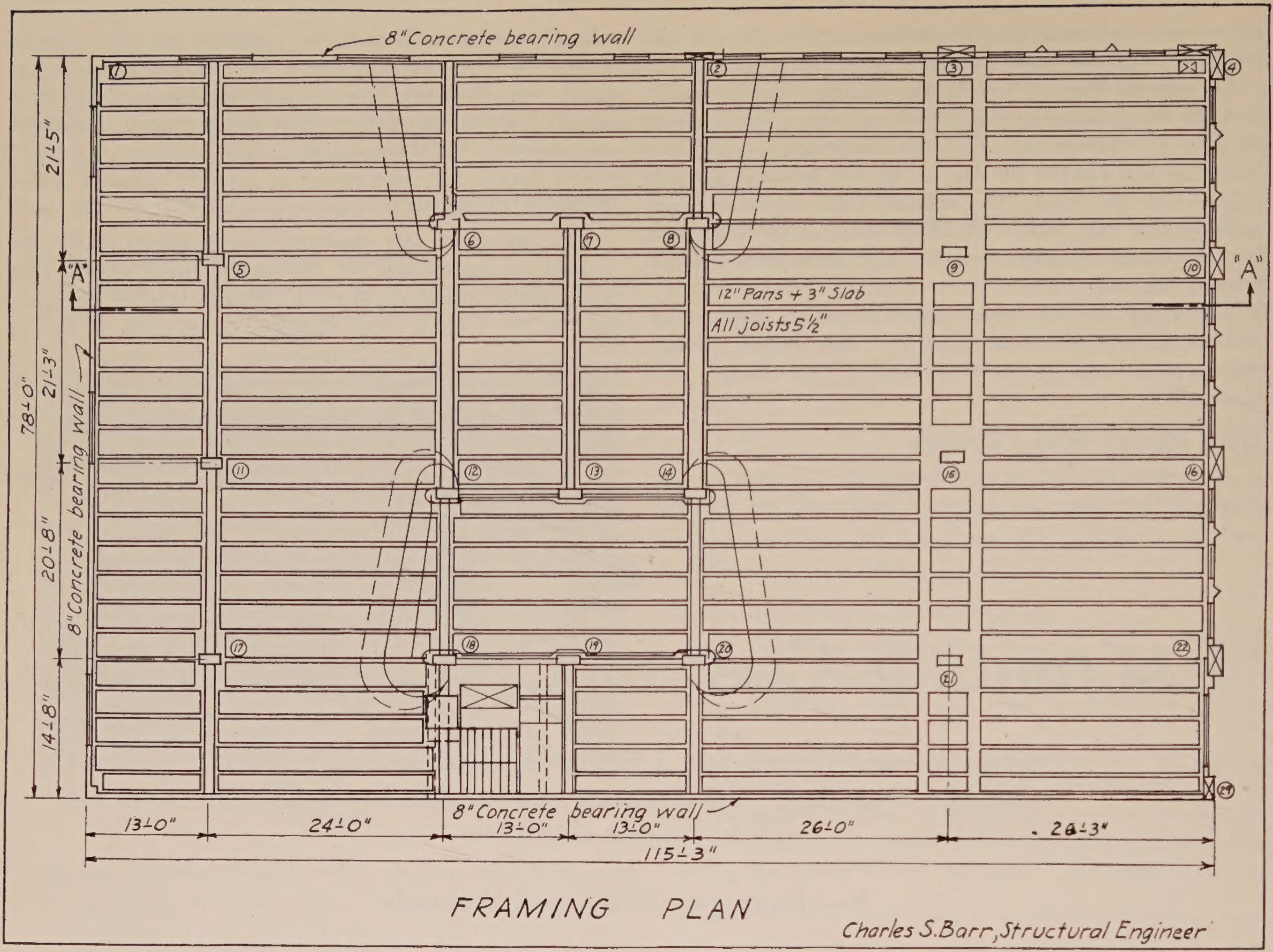
External walls and columns are all of concrete and had to be concreted together. Fifty per cent of the $2.00 figure given in previous article would be $1.00 per cu. yd.; but owing to the specially difficult nature of this particular job, placing concrete in walls is priced at $1.40, making total cost of mixing and placing in walls and columns $1.74 per cu. yd.

Concrete floor slabs are in most cases only three inches thick, and this, together with the large number of small joists, involved much more labor in placing and spading than in ordinary cases. This labor was therefore priced at $1.10 per cu. yd., making the total cost of labor for floor concrete $1.42 per cu. yd.

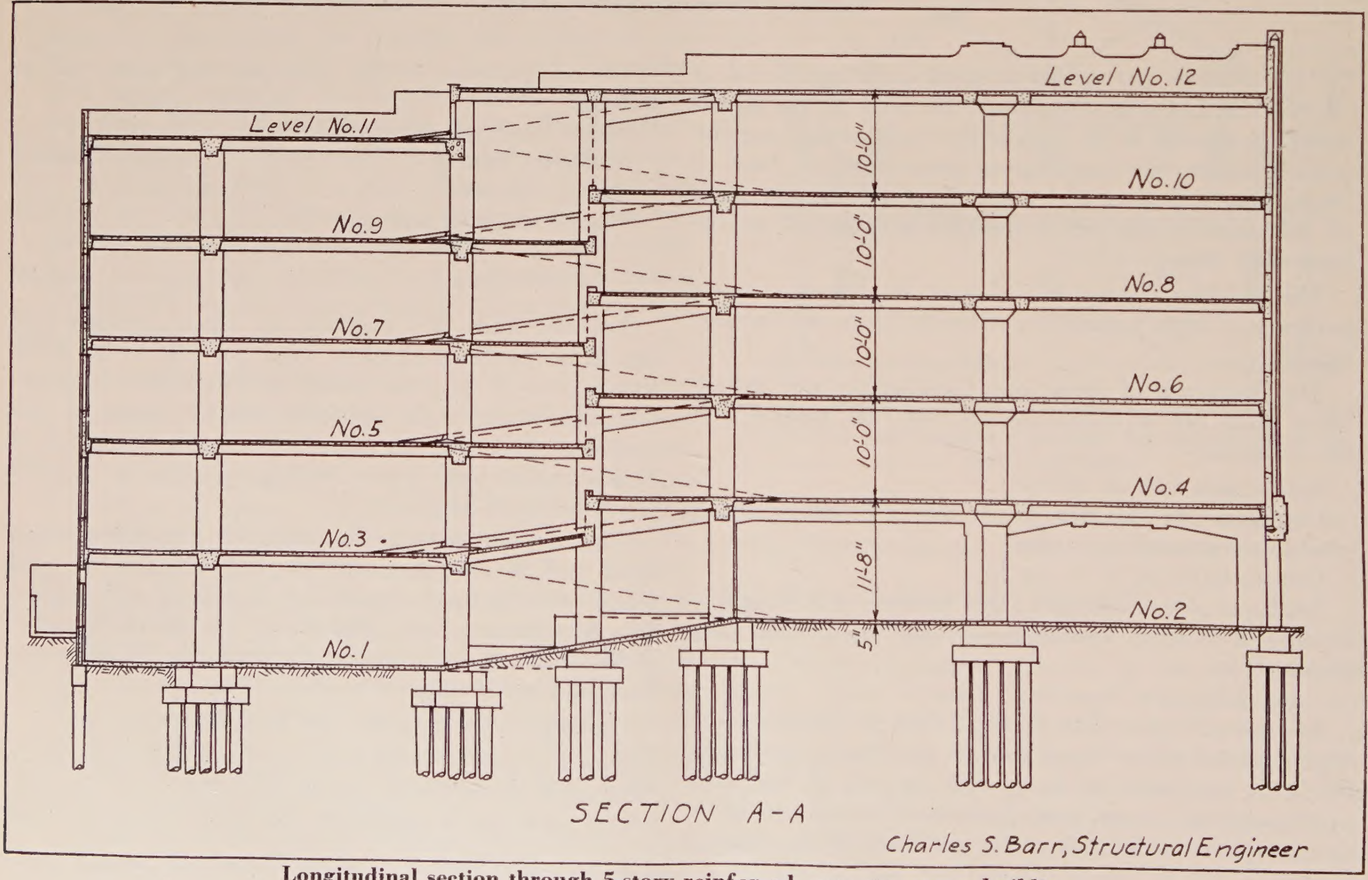
Concrete material prices were as follows:

Portland cement in cloth f.o.b. cars, per bbl.	$2.27
Sand f.o.b. job in trucks, per cu. yd.	2.00
Gravel f.o.b. job in trucks, per cu. yd.	3.50

In this city there is no local supply of suitable sand



Typical framing plan for 5-story reinforced concrete garage building



Longitudinal section through 5-story reinforced concrete garage building and gravel. These materials had to be hauled in by rail from a considerable distance.

The cost of a cubic yard of mixed concrete material was worked out as follows:

Portland cement, per bbl.	$2.27
Deduct credit for bags	.40
	$1.87
Loss on M. T.'s and return freight	.05
Tests	.03
Trucking	.10
Total per bbl.	$2.05

1:2:4 concrete—

Cement	1.5 bbl.	@ $2.05	$3.08
Sand	0.5 cu. yd.	@ 2.00	1.00
Gravel	0.9 cu .yd.	@ 3.50	3.15
Total per cu. yd.			$7.23

1:1½:3 concrete—

Cement	2.0 bbl.	@ $2.05	$4.10
Sand	0.5 cu. yd.	@ 2.00	1.00
Gravel	0.9 cu. yd.	@ 3.50	3.15
Total per cu. yd.			$8.25

Form labor was computed as follows (units given are per "square" of 100 sq. ft.):

Foundation forms, 4,770 sq. ft.—

Make panels	2,400 sq. ft.	@ $ 4.50[1]	$108.00
Erect	4,770 sq. ft.	@ 15.00	715.50
Strip	4,770 sq. ft.	@ 1.50	71.55
Total labor (average $18.77 per sq.)			$895.55

Exterior column forms have a contact surface of 2,855 sq. ft.

There are five of these and the front faces are ornamented with grooved flutings and panels. This ornament varies on the different floors, which necessitated a good deal of remaking.

Making panels, sides and backs 500 sq. ft. @ $6.00[1]	$ 30.00
Making face panels 1,000 sq. ft. @ $15.00	150.00
Extra cost of ornament, 2nd floor, No. 6, @ $4.00(e)	24.00
Extra cost of ornament, 5th floor, No. 6, @ $3.00(e)	18.00
Erection (including ornament) 2,855 sq. ft. @ $16.00	456.80
Strip 2,855 sq. ft. @ $2.00	57.10
Total labor (average $25.78 per sq.)	$735.90

The cartouches at the fifth floor and the finials on the parapets are of precast concrete, and therefore no form work is included for these items.

Interior column forms, 6,360 sq. ft.

Make panels	1,500 sq. ft.	@ $ 6.00[1]	$ 90.00
Erect	6,360 sq. ft.	@ 12.00	763.20
Strip	6,360 sq. ft.	@ 2.00	127.30
Total labor (average $15.41 per sq.)			$980.40

Brackets on interior columns total 15 in number.

Make	No. 5	@ $3.50	$17.50
Erect	No. 15	@ 2.25	33.75
Strip	No. 15	@ .50	7.50
Total labor (average $3.92 each)			$58.75

Forms for walls, 40,816 sq. ft.

Make	10,000 sq. ft.	@ $ 4.50[1]	$ 450.00
Erect	40,816 sq. ft.	@ 12.00	4,897.20
Strip	40,816 sq. ft.	@ 2.00	816.32
Total labor (average $15.08 per sq.)			$6,163.52

Forms for floors (metal pan construction), 44,850 sq. ft.

Make beam bottoms only 3,000 sq. ft. @ $5.00[1]	$ 150.00
Make posts, jacks, etc.	50.00
Erect (incl. pans) 44,850 sq. ft. @ $7.00	3,139.50
Strip 44,850 sq. ft. @ 1.50	672.75
Total labor (average $9.39 per sq.)	$4,012.25

Forms for girders, 2,275 sq. ft.

Make	500 sq. ft.	@ $ 6.00[1]	$ 30.00
Erect	2,275 sq. ft.	@ 12.00	271.00
Strip	2,275 sq. ft.	@ 1.50	34.13
Total labor (average $14.73 per sq.)			$335.13

Form Lumber Required

	Sq. Ft.			Uses	F.b.m.
Foundations, contact area	4,770	× 3	= 14,310	÷ 2	= 7,155
Exterior columns, contact area	2,755	× 3	= 8,265	÷ 3	= 2,755
Interior columns, contact area	6,360	× 3	= 19,080	÷ 5	= 3,816
Walls	40,816	× 2½	= 102,040	÷ 5	= 20,408
Floors (beam bottoms)	9,000	× 2	= 18,000	÷ 5	= 3,600
Floors, posts, jacks & ledgers	44,850	× 2	= 89,700	÷ 5	= 17,940
Girders	2,275	× 3	= 6,825	÷ 5	= 1,365
Miscellaneous	1,000	× 4	= 4,000	÷ 2	= 2,000
Total area	110,826			Total lumber required	59,039
Less beam bottoms	9,000				
Net contact area	101,826				

For estimating purposes, say 60,000 f.b.m.

Metal pans were used on a gross area of 44,850 sq. ft. (pans used five times). Steel company's quotation of $1,550 equals about 3½ cents per sq. ft.

Reinforcements

Steel bars in carload shipments cost $2.40 per 100 lb. ($48.00 per ton).

Total tonnage of bars—92 @ $48.00	$4,416.00
Differential, add	
3 tons @ $20.00	60.00
15 tons @ 8.00	120.00
6 tons @ 4.00	24.00
Total cost of bars f.o.b. cars	$4,620.00
Scheduling—$1.50	$ 138.00
Cutting and bending—$7.00	644.00
Unloading and trucking—$2.00	184.00
Total cost of steel f.o.b. job (avg. $60.72 per ton)	$5,586.00

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[1] Unit costs in this column are per "square" of 100 sq. ft.

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Granolithic Finish

The granolithic finish was laid integral with floor slabs and paving. The cost of materials in 100 sq. ft. of 1-in. finish was estimated as follows:

1.25 bbl. cement @ $2.05	$2.56
.33 cu. yd. sand @ $2.00	.67
	$3.23
Deduct 0.33 cu. yd. concrete material displaced by finish @ $7.23	$2.41
Net extra cost of material in finish	$0.82
Labor on finishing granolithic	$5.00

Plant

The plant estimate was made on the assumption that it would take 18 weeks to complete the concrete work. The details follow:

	Labor	Material, Rental, etc.	
Mixer and motor rental, 18 weeks		$35.00	$ 630
Electric hoist rental, 18 weeks		30.00	540
Concrete bucket, hopper, boom, etc., rental (18 weeks)		6.00	108
Level or transit rental (18 weeks)		3.00	54
Lumber for tower, about 80 ft. high, 3 M		20.00	60
Bolts and guys for same			50
Small tools, barrows, buggies, etc. $850.00			
Less probable salvage 350.00			
			500
Oil and waste, rope and hose, sundries			200
Lumber for runways and miscl. uses			100
Power, fuel and water			200
Trucking plant to and from the job			75
Temporary buildings, labor and lumber	$100		200
Telephone			100
Labor, erecting mixer	100		
Labor, erecting wood tower and hoist	150		
Labor, erecting dismantling plant	100		
Total estimated plant cost	$450		$2,817

Summary

The summary of the estimate is as follows (fractions of a cent are disregarded in using the unit prices worked out in preceding paragraphs):

	Labor		Material	
Concrete,				
Foundations, 1:2:4, 155 c.y.	$ 1.09	$ 169	$7.25	$ 1,124
Columns, 1:1½:3, 159 c.y.	1.74	277	8.25	1,312
Walls, 1:2:4, 436 c.y.	1.74	748	7.25	3,161
Paving, 1:2:4, 115 c.y.	1.00	115	7.25	834
Floors and girders, 1:2:4, 817 c.y.	1.42	1,160	7.25	5,923
Stair slabs, c.y.	3.00	12	7.25	29
Stair risers (incl. finish), 240 l.f.	.30	72	.15	36
Precast concrete column ornaments, fifth floor, including models, No. 4	5.00	20	25.00	100
Precast column ornaments, parapet,				
Large, No. 4	1.00	4	6.00	24
Small, No. 8	1.00	8	4.00	32
Forms,				
Foundations, 4,770 s.f.	.19	906		
Exterior columns, part fluted, 2,855 s.f.	.26	743		
Interior columns, 6,360 s.f.	.15	954		
Brackets on interior columns, No. 15	4.00	60		
Walls, 40,816 s.f.	.15	6,121		
Floors, metal pan, 44,850 s.f.	.09½	4,261		
Girders, 2,275 s.f.	.15	341		
Penthouse slab, 225 s.f.	.15	34		
Stair soffits, 382 s.f.	.20	76		
Stair risers, 240 s.f.	.22	53		
Extra cost of curved top to parapet, 380 l.f.	.15	57		
Form lumber, 60 M. f.b.m.			22.00	1,320
Nails, oil, bolts, etc.				300
Metal pans				1,550
Steel reinforcement, 92 tons	15.00	1,380	60.72	5,586
Accessories				125
Wire mesh reinforcement, slabs and paving, 59,500 s.f.	.00¾	446	.03	1,785
Finishes,				
Granolithic, 44,800 s.f.	.05	2,240	.01	448
Float roof slabs, 8,800 s.f.	.01½	132		
Patch interior concrete surfaces, 30,750 s.f.	.01	308		
Rub exterior surfaces with carborundum, 21,800 s.f.	.04	872		
Plant and tools, etc.		450		2,800
Permit and city inspector				600
Superintendent and timekeeper, 18 weeks		1,800		
Total		$23,819		$27,089

Labor	$23,819
Insurance @ 6 per cent	1,429
Material	27,089
Estimated net cost of concrete construction, not including contractor's profit	$52,337

Effect of Water-Gas Tar Protection on Strength of Concrete

The effect of water-gas tar protection on the strength of concrete and its resistance to alkali attack is reported in the June (1931) issue of *Public Roads*, by Dr. E. C. E. Lord, petrographer, U. S. Bureau of Public Roads.

The tests reported were made on treated and untreated specimens stored out of doors in tap water at Arlington Farm, Va., and in the sulphate water of Medicine Lake, S. D.

The results of the investigations lead to the following conclusions:

1. The compressive strength of concrete cured for varying periods in damp and dry air and treated with 4 or more coats of water-gas tar and 1 coat of coal tar is somewhat lowered during early stages of hardening under water, but this loss is ultimately almost fully regained.

2. During the early stages the strength decreases rather uniformly with increasing quantities of tar absorbed. When ultimate strength is attained, however, the effect of the water-gas tar protection is negligible.

3. The protection against alkali action afforded concrete by the tar treatment is influenced by the cement content, method of curing and consistency of mix, being most effective in rich mixes of medium consistency cured for a minimum length of time in dry air.

4. Concrete of wet consistency is less tar-absorptive and offers lower resistance to alkali attack than concrete of medium consistency cured in the same manner, although no positive relation is shown to exist between the amount of tar absorbed and the resistance to alkali attack.

5. The protection to concrete afforded by the water-gas tar treatment, under the severe conditions imposed in this investigation, was increased only to a limited extent by the application of a non-penetrable surface coat of coal tar.

6. Concrete of high cement content, cured for a limited period in dry air and treated with water-gas tar is capable of offering appreciable resistance to alkali attack under the conditions imposed in the foregoing investigation.

Contracting Company Expands Into Ready-Mixed Concrete

Schmitt Organization in St. Louis Creates Well Established Market—Material Delivered in Agitator Bodies—Plant Has Complete Mechanical Equipment

THE ready-mixed concrete plant operated by the Fred Schmitt Realty & Investment Co., at 650 Rosedale Ave., St. Louis, is an example of a business that was developed in response to an evident demand.

A Contractor Who Expanded

Originally the Fred Schmitt Realty & Investment Co. was engaged principally in the contracting business, and the company is still in that business. In its building work the company uses much lime mortar, for the St. Louis building code permits the use of untempered lime mortar in brick buildings of nearly all occupancy up to heights of 3 stories.

Build Lime Mortar Plant

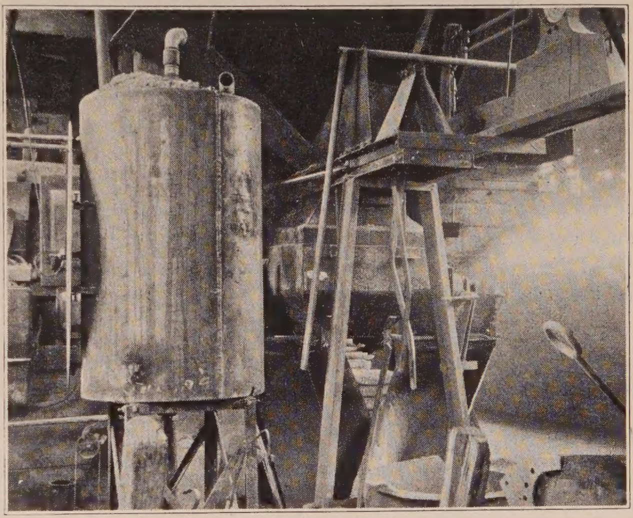
Because of the great number of small contracts obtained by the company, and the inconvenience of mixing lime mortar at each job, the Schmitt organization built a central mortar mixing plant in 1925, in the building which was later extended to house the ready-mixed concrete plant. The intention at first was to supply mortar only to the company's own contracts; but other contractors were quick to see the advantages of getting mortar from this central plant, and soon the company found itself doing a regular retail business in the sale of mortar.

Aggregates are delivered to a track pit from hopper-bottom cars

The success of the lime mortar plant suggested a logical expansion to include the sale of ready-mixed concrete. A plant with a capacity of 55,000 cu. yd. annually was built in 1927, in an extension of the company's main building, which also contains the lime mortar plant and the company offices.

Mechanical Equipment

The ready-mixed concrete plant, like the lime mortar plant, is supplied with complete mechanical equipment.



The mixing floor, showing water tank and equipment for weighing aggregates

Aggregates, for instance, are delivered to a track pit from hopper-bottom railway cars. From the pit the material is elevated to overhead bins by means of a vertical bucket conveyor consisting of a single 2-yd. bucket counterbalanced by a concrete weight. The unloading capacity of this equipment is 10 cars daily.

Cement is brought from the warehouse to the mixing floor in bags, on a sloping belt conveyor about 100 ft. long. A second conveyor, of the vertical type, and served by another railway siding, brings up emergency supplies of cement, bags of admixture and other materials, to the mixing floor.

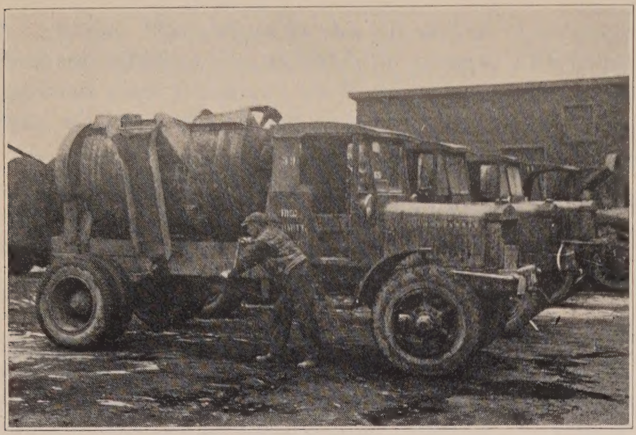
Sand and Gravel Storage

Mississippi River screened sand and Meramec River gravel are used exclusively. The gravel is supplied in two sizes. The coarse size (1½ to ¼ in.) is used for the general run of mass and structural concrete. The smaller size (¾ to ⅛ in.) is often specified for sidewalks, ribbed floor slab construction and related uses.

The overhead storage facilities consist of 2 bins for coarse gravel with a capacity of 6 cars each; 2 bins for finer gravel, capacity 5 cars each; and 2 bins for sand, each with a capacity of 5 cars.

Mixing the Concrete

Concrete is supplied in any proportions specified or on a strength basis. Cement and aggregates are weighed. The mixing water, supplied from the company's own well, is measured in a tank which is equipped with a water control device. The water tank and the batch weighing equipment may be seen in the illustration of the mixing floor.



Group of large trucks equipped with 3-cu. yd. agitator bodies, discharging at the side

Mixer and Truck Equipment

The mixers are of the 3 cu. yd. half drum type, with a spiral rotor blade. For the company's small trucks, batches of 1 or 1½ cu. yd. can be mixed.

Half-Drum Type Mixers

Truck equipment consists of 24 large units equipped with agitator bodies of 3 cu. yd. capacity, and 5 smaller trucks, also with agitator bodies, with capacities of 1 or 1½ cu. yd. A group of the large bodies may be seen in one of the illustrations. All the agitator bodies are the half drum type, with a spiral rotor blade, and all discharge at the side. The truck bodies and plant mixer were built by the Concrete Transport Mixer Co., of St. Louis.

Portable Chute for Delivery

A portable chute with a funnel-shaped upper end is carried on the side of all trucks, to facilitate delivery of concrete wherever the chute can be utilized to advantage.

Cost and Delivery Charges

The company delivers concrete anywhere within the city at a fixed price. Present prices range from $6.50 to $8.40 per cu. yd.

Additional charges are made for delivery outside the city, the exact charge depending on the distance. Deliveries have been made within a radius of 25 miles.

Delivery System

During the year 1931 a new system of delivery has been developed, due to the long hauls necessary when deliveries were all made from the central plant. The custom now is to drive into the nearest material yard having weighing batchers for the correct proportioning of the concrete, and mixing en route to the job with one, two, or three cubic yard mixers as required. This method speeds up the service, cuts down the delivery time, and takes the load off the central plant at the peak hours.

How Orders Are Handled

When an order is received in the office it is approved and entered in the books, then turned over to the shipping clerk. He schedules the order in accordance with the time schedule established and the truck equipment available, and sends a copy to the mixer operator on the mixing floor, on a cord and pulley device. This copy contains the gist of the specification requirements, from which the mixer operator determines the proportions and water content for the batch from schedules outlined by the plant engineer.

Cold Weather Facilities

As with many ready-mixed concrete plants, supplying warm concrete during cold weather is simply a matter of mechanical installation. An oil burner heats the water in the supply tank, which is connected to the control tank at the mixer. Steam coils have been installed in all the overhead storage bins for heating the sand and gravel when necessary.

Testing by Outside Laboratories

At the present time all testing of specimens of concrete is done by outside laboratories. The company is giving consideration to the installation of its own testing equipment, not as a matter of economy, but as a matter of convenience.

View of main building, in which ready-mixed concrete and lime mortar are produced

Ready-mixed concrete has come into general use in St. Louis, and but little sales resistance is now encountered because of hesitancy on the part of engineers and architects.

Cutting Corners in Concrete Structural Design

Charts Aid in Design of Beams and Slabs Where Clearance Requirements Force Use of Shallow Depths

II—Compression Steel in Concrete Beams and Over-Reinforced Slabs

By J. R. GOETZ[1]
Structural Engineer, Chicago, Ill.

ARCHITECTURAL requirements frequently demand the use of undersized beams and slabs, for clearance purposes. While such beams and slabs are rather uneconomical and the designer should avoid their use so far as possible, he should also have a quick method of design when they do become necessary. For beams, either with or without tees, the better method is the introduction of compression steel, while with slabs, owing to the comparatively small effective depth, an unbalancing caused by an increase in tension steel is often a sufficient method of increasing the strength.

Compression Steel in Beams

Nearly all the methods used at present for designing beams with compression steel depend upon the ratio of the covering of the compression steel to the effective depth, or $d' \div d$. Instead of assuming a value for this ratio, let us take the covering of the compression steel as a fixed quantity. This should be at least 1 in. clear, or say 1½ in. to the center of the steel. Then the total stress in the compression steel =

$$A'_s \left[(n-1)\, f_c \left(\frac{Kd - 1\frac{1}{2}}{Kd} \right) \right]$$

and the total moment in ft.-lb. resisted by the compression steel =

$$A'_s \left[\frac{(n-1)\, f_c \left(\frac{Kd - 1\frac{1}{2}}{Kd} \right) (d - 1\frac{1}{2})}{12} \right]$$

or, calling the quantity within the brackets G, $M_2 = A'_s G$ or $A'_s = M_2 \div G$. The quantity M_2 represents the total moment to be resisted, minus the moment taken by the beam without compression steel, or $M_2 = M - Kbd^2$. Therefore $A'_s = [M - Kbd^2] \div G$.

Curves plotted on Chart 1 show values of $G \div 1{,}000$ against values of d, the effective depth, for $f_c = 800$ and 900 and $f_s = 20{,}000$ lb. per sq. in.

Example

Given a beam limited in size to $b = 16$ in. and $d = 26$ in., which must resist an external bending moment of 180,000 ft.-lb. Design both the compression and the tension steel. From the slide-rule design method given in the preceding article, the resisting moment of the beam without compression steel = 118,300 ft.-lb., and the area of tension steel for such beam = 3.12 sq. in. This moment deducted from 180,000 ft.-lb. = 61,700 ft.-lb., which is to be resisted by compression steel and further tension steel. From the curve, under a depth of 26 in. the value of $G = 19{,}350$. Therefore,

$$A'_s = \frac{61{,}700}{19{,}350} = 3.19 \text{ sq. in.}$$

The total area of tensile steel =

$$3.12 + \frac{61{,}700 \times 12}{20{,}000 \times 24.5} = 4.63 \text{ sq. in.}$$

This method is exact and requires no redesign due to an inaccurate estimate of the ratio $d' \div d$.

It has been the writer's practice to limit the area of compression steel to approximately that of the tension steel when possible. Then $A'_s = A_s$. Assuming that $A_s = M \div f_s jd$ (which is not strictly correct for beams with compression steel) and that $A'_s = [M - Kbd^2] \div G$, equating these expressions and solving for M/b, we have

$$\frac{M}{b} = \frac{Kd^2}{1 - \frac{(n-1)\, f_c}{f_s j} \left[\frac{\frac{kd - 1\frac{1}{2}}{Kd} (d - 1\frac{1}{2})}{d} \right]}$$

Curves are also plotted on Chart 1 for values of M/b against values of d, when $A'_s = A_s$ and $f_c = 800$ and 900 lb. per sq. in. Here f_s is again taken as 20,000 lb. per sq. in.

Example

Given a beam of width = 16 in. to resist a moment of 180,000 ft.-lb. What is the effective depth when $A'_s = A_s$? In this case, $M \div 1{,}000\, b = 180{,}000 \div 16{,}000 = 11.25$, and following the value across from the curve, we find $d = 22.9$ in. Exact values of A'_s and A_s are then found, as shown above, to be 5.35 sq. in. and 5.22 sq. in. respectively.

Over-Reinforced Slabs

The curves on Chart 2 give a quick method of determining the area of tension steel in slabs which have been unbalanced by decreasing the normal effective depth, and are based upon the variation of the values of f_s and j. To use these curves, divide the available effective depth to the steel by the square root of the moment in ft.-lb. per ft. width. This value, called d, is followed horizontally

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[1] Formerly chief engineer for Ben Marshall, architect, Chicago, Ill.

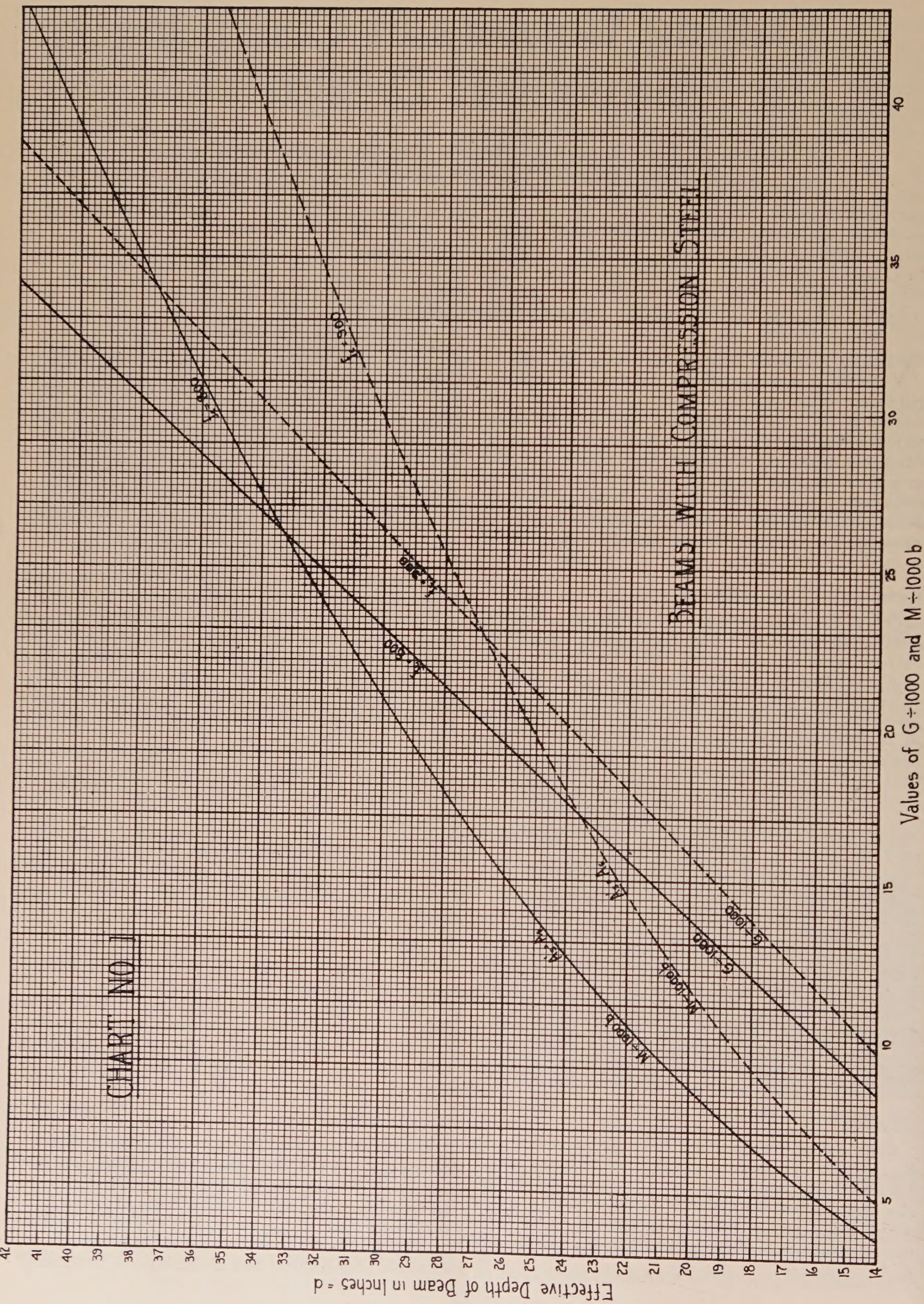
CHART NO 1
BEAMS WITH COMPRESSION STEEL
Values of G ÷ 1000 and M ÷ 1000 b
Effective Depth of Beam in Inches = d
5
10
15
20
25
30
35
40
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
K = 900
K = 800
K = 300
K = 500
A's = As
As = A's
M - 1000 b
M - 1000 b
G - 1000
G - 1000

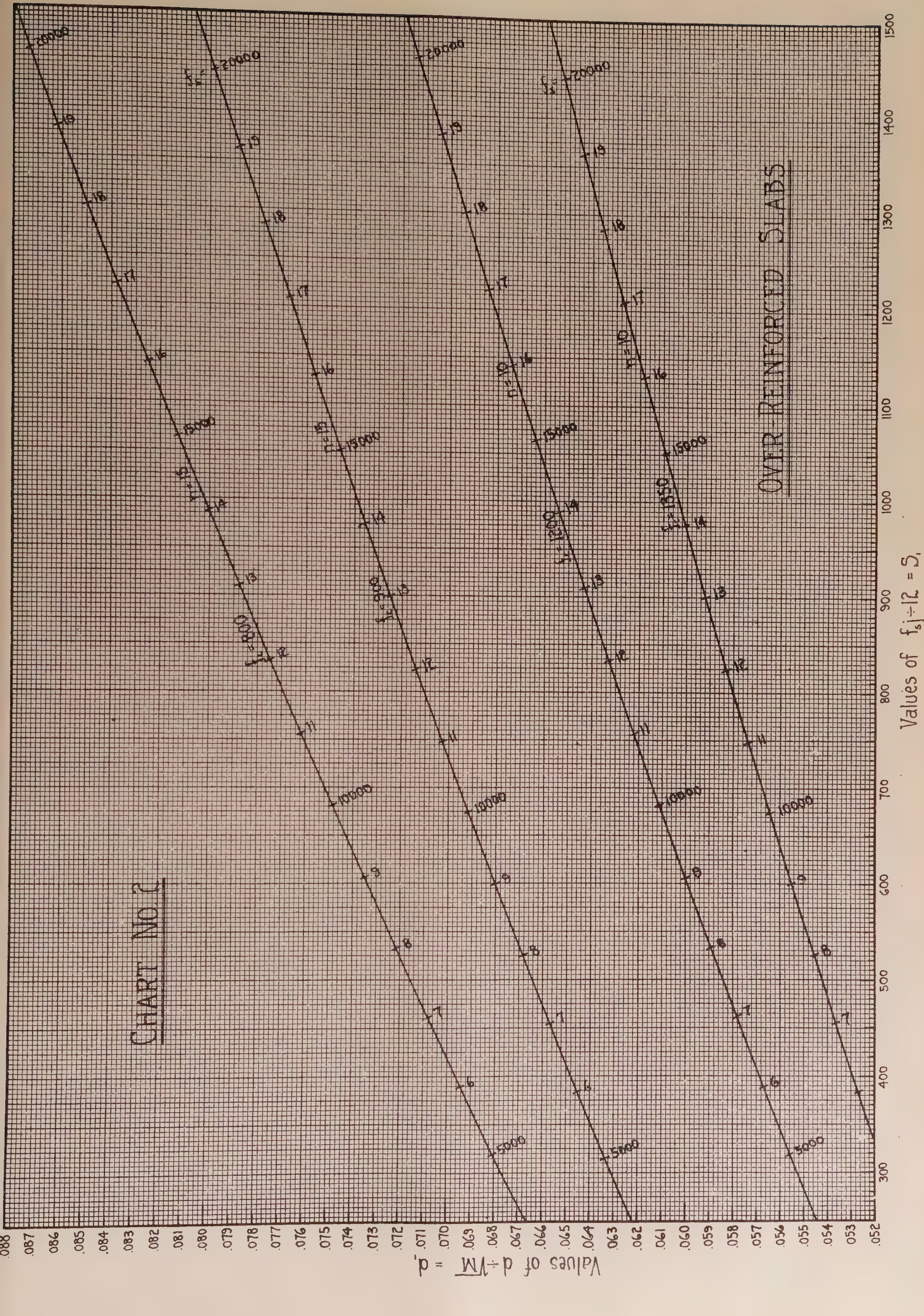
CHART NO. C
OVER-REINFORCED SLABS
Values of $f_s j \div 12 = S$
Values of $d \div \sqrt{M} = d_1$
$f_c = 800$
$n = 15$
$f_c = 900$
$n = 15$
$f_c = 1200$
$n = 10$
$f_c = 1350$
$n = 10$
$f_s =$
5000
10000
15000
20000
6
7
8
9
11
12
13
14
16
17
18
19
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
.052
.053
.054
.055
.056
.057
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.062
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.065
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.067
.068
.069
.070
.071
.072
.073
.074
.075
.076
.077
.078
.079
.080
.081
.082
.083
.084
.085
.086
.087
.088

across the chart to the proper curve and thence down to the lower scale to values of $fj \div 12$ (called S_1). Then

$$A_s = \frac{M}{S_1 d}$$

Example

Given a moment of 7,000 ft.-lb. per ft. width of slab and an allowable effective depth of 6 in. The

$$d_1 = \frac{6}{\sqrt{7{,}000}} = 0.0718$$

and $S_1 = 518$. Therefore $A_s = \dfrac{7{,}000}{518 \times 6} = 2.25$ sq. in. per ft. If a slab of effective depth of 7 in. could have been used,

$$d_1 = \frac{7}{\sqrt{7{,}000}} = 0.0837 \text{ and } S_1 = 1{,}215, \text{ giving}$$

$$A_s = \frac{7{,}000}{1215 \times 7} = 0.822 \text{ sq. in. per ft.}$$

From this example it can readily be seen how uneconomical it becomes to limit the depth of slabs to much below the normal depth required, as the fiber stress in the steel becomes so low (in this case, less than 8,000 lb. per sq. in.).

Computing Proportions for Concrete From Data on Aggregates

Smith's Method in September Issue Commended by Engineer—Called Logical and Sensible

The article by Archie A. Smith, printed on pages 17-19 of the September (1931) issue of CONCRETE under the title of "Proportions for Concrete Computed From Data on Aggregates," has brought the following comment from D. D. McGuire, formerly engineer of tests in the Tennessee State Highway Department:

Editor, CONCRETE:

I think the article which you carry on Page 17, September issue, CONCRETE, is without question the most logical and common-sense method of proportioning concrete that I have ever had the opportunity of studying.

This procedure seems to be very concisely stated and based on logical thoughts.

I should like to know, from the author, how he arrives at the thickness of mortar coating for coarse aggregate pieces, and why he uses the factor 0.0032 in his computation for mortar thickness.

In Table 2, the information is given that the cement paste coating on sand particles is 0.0022.

If this point can be cleared up, I think the entire procedure is by far the most satisfactory that I have ever heard of.

D. D. MCGUIRE,
Assistant to the President,
Standard Building Materials Co.

St. Louis, Mo.,
Sept. 2, 1931.

Ready-Mixed Concrete Interests City Officials Group

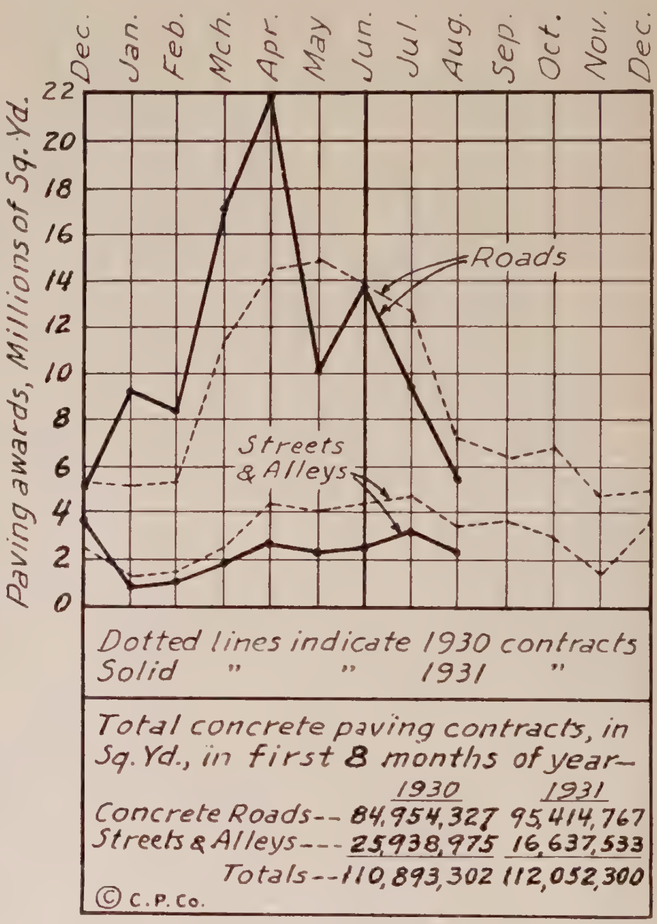
Ready-mixed concrete, subgrades, and street maintenance were among the subjects discussed at a meeting of the executive committee of the City Officials Division of the American Road Builders Association at the Hotel Statler in Detroit on Friday, September 4.

Concrete Paving Awards Hold Lead Over Record of 1930

Disagreement Over State Wage Law Holds Up Work in Illinois—Street Paving in Moderate Volume

The tangle in Illinois, caused by disagreements over the provisions of the prevailing-wage law adopted by the legislature early this year, has held up the award of several million square yards of concrete paving in that state. The situation has now been complicated further by an opinion of a lower court holding the law unconstitutional.

Partly as a result of the tie-up in Illinois, awards for concrete roads in the United States during the month of August totaled only 5,437,434 sq. yd., compared with 7,242,839 sq. yd. in August, 1930. Concrete street and alley paving contracts amounted to 2,237,265 sq. yd., compared with 3,414,129 sq. yd. in the corresponding month of last year, according to figures compiled by the Portland Cement Association.



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For the first eight months of this year concrete road awards totaled more than 10 million square yards ahead of the first eight months of 1930; but all concrete pavement awards, including roads, streets and alleys, are less than 2 million square yards above the corresponding figures for 1930.

EDITORIAL

Build Highway Structures This Winter

MANY phases of concrete highway construction work should be continued throughout the fall and winter months. This policy is actually being adopted by some state highway departments, partly for the purpose of providing winter employment and partly with the view of spreading out the year's work for the highway department itself.

So far as concrete road slabs are concerned, it would be possible, though wholly impracticable, to place warm concrete in cold weather and keep it warm during the curing period. With the best organized contractors placing from 1,500 to 2,000 lin. ft. of road slab in a single day, the cost of putting up a continuous protecting inclosure and keeping it heated would be prohibitive.

Considering more compact and costly structures, such as bridges, elevated highways and grade separation structures, the story is quite different. Here the work is usually concentrated within the length of a thousand feet or less, and the cost of the structure, per linear foot, is many times that of a road slab. In consequence, the additional cost of placing warm concrete and keeping it warm is only a small percentage of the total cost.

Mixing and placing methods and a form of protecting inclosure well adapted to structures of this type and shape are described by L. W. Skov in the leading article in this issue of "Concrete."

The state highway department of Illinois is one of those who expect to carry on with bridges and grade separation structures, regardless of cold weather. Almost every state and county highway department can, with profit to all concerned, push similar work during the coming winter season, thereby clearing the deck for undivided attention to straightaway road construction next spring and summer.

Too Many Fires in Products Plants

DURING the past twelve months an unusual number of reports have been received of the destruction, by fire, of concrete products manufacturing plants.

The most recent case, in Pennsylvania, was typical of others. The building had walls of concrete masonry units, but the roof was entirely of wood construction and there was much inflammable material and equipment in the interior.

The destruction of a concrete products plant by fire is the poorest kind of advertising for concrete building units in the community where the fire occurs.

Every fire of this character also demonstrates more clearly that one of the needs of the concrete products industry is to establish itself in better quarters. That means buildings which not only have exterior walls of concrete masonry units, but in which the floors, the roof, and the interior walls and partitions are of incombustible construction; and, so far as possible, shelves, bins and handling equipment should be of metal.

Some years may elapse before the entire industry is housed in buildings of this type, two of which are illustrated in an article in "Concrete," in the issue of July, 1930, page 20.

In the meantime owners of the older types of plants can do much to prevent fires, by observing better housekeeping methods. The best way for such owners to celebrate national fire prevention week is to make it clean-up week in their own plants.

A Lasting Form of Fire Prevention

FIRE prevention week, coming at this season when household furnaces are started, may be made to mean much or little within a given community.

If the week's program is merely a continual round of speech-making and ballyhoo, little permanent benefit may be expected. Such a program may lead to the removal of the year's accumulation of rubbish in residential basements, but in due time more rubbish will be accumulated in its place.

In the meantime the real danger from fires in the basements of dwelling houses and small apartment buildings will not have been removed, for if the fire can find its way above the basement, disaster may be the result, especially if the fire occurs late in the night

Here, then, is the potential field—making basements of dwellings and other non-fireproof types of buildings safe against the spread of fires that start in them. Even with old buildings this may be done. Usually it means the placing of a ceiling of metal lath and cement plaster, with the same construction carried down the side walls to the foundation wall masonry. It means isolation of the furnace room by means of a fireproof partition, and self-closing metal-clad doors opening into the basement. With all this accomplished, a basement fire may burn itself out before it is able to break through the barriers.

If the concrete construction interests of a community can develop a fire prevention week program that will drive home a realization of these simple facts about basements and basement fires, a real and lasting service will have been performed.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Adopt Federal Specifications for Concrete Masonry Units

THE Federal Specifications Board of the United States Bureau of Standards has officially adopted and promulgated a standard purchase specification entitled Hollow Concrete Masonry Units, and designated by the symbol SS-C-621.

October 15, 1931, has been set as the mandatory date, after which the purchasing sections of all departments and independent establishments of the federal government are expected to adhere to these specifications in the purchase of this material.

Copies of this new standard specification may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Simplified Practice Recommendation for Steel Reinforcing Bars

SIMPLIFIED Practice Recommendation R 26-30, Steel Reinforcing Bars, has been accepted by the industry as revised in 1930, and has now been promulgated by the United States Department of Commerce through the Division of Simplified Practice of the Bureau of Standards.

The standard bar sizes and their accepted cross-sectional area are given in the following table:

Area (in square inches)	Sizes of square and round bars (in inches)	Area (in square inches)	Sizes of square and round bars (in inches)
0.05	¼ round	0.60	⅞ round
.11	⅜ round	.79	1 round
.20	½ round	1.00	1 square
.25	½ square	1.27	1⅛ square
.31	⅝ round	1.56	1¼ square
.44	¾ round		

Copies of Simplified Practice Recommendation R 26-30, in the form of a 12-page printed pamphlet, may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Transportation Engineering Course at University of Michigan

The University of Michigan has started on the second year of what may be considered a new departure in engineering education, namely, a 4-year course in transportation engineering. The work comprises railway, marine, automobile, aeronautical, and highway engineering.

This new curriculum parallels the other established divisions in engineering education and offers a program leading to the degree of bachelor of science in engineering (transportation). Basing their studies upon the fundamental courses in engineering, students enrolling in this new division are expected to give at least one-fourth of their time to subjects of distinctly cultural content. Moreover, survey courses in all the branches of modern transportation will be required, with intensive studies during the senior year in some special branch of the field, completing a well-rounded program.

Continuing Study of Masonry Cements

IN its study of masonry cements, Committee C-1 on Cement, of the American Society for Testing Materials, reports that the committee has found a considerably increased interest in the questions of what should be the requisite properties for masonry cements and what methods of tests should be employed for such materials. These questions are now being actively studied and there should soon be sufficient data available to enable the committee to offer a specification for masonry cements.

The committee has listed 23 different manufacturers who are now making a plastic cement for the setting of masonry.

Bridge and Highway Engineering Are Subjects of Two Volumes

TWO volumes of value to bridge engineers and highway engineers have just been published by the American Association of State Highway Officials. One volume, "Tentative Standard Specifications for Highway Materials and Methods of Sampling and Testing," contains a comprehensive summary of all specifications in this field that have been adopted by the association. The other volume, "Specifications for Highway Bridges and Incidental Structures," contains in complete form the standards adopted by the association. It covers everything pertaining to concrete, steel or timber bridges.

The books may be obtained for a nominal sum from the American Association of State Highway Officials, National Press Building, Washington, D. C.

Specifications for Terrazzo Work

THE specifications for terrazzo floors mentioned in the May issue of CONCRETE on this page, have now been published in printed specification form by the National Terrazzo and Mosaic Association, under the title of "Specifications for Terrazzo Work."

This new specification, which has been in course of preparation for several years, is the work of a committee which represents the main geographical sections of the United States and Canada. In preparing the specification the committee made every effort to utilize the best features of the various specifications previously in use. It is therefore expected that this new standard will bring about a closer approach to uniformity in practice.

Copies of the specification can be obtained from the National Terrazzo and Mosaic Association, 815 West St. Paul Ave., Milwaukee, Wis.

Developing Random Ashlar Market for Interiors and Exteriors

Attractive Coloring and Coursing Effects—Employing a Mason to Prove Your Case—Some Manufacturing and Sales Rules to Keep in Mind

By F. W. MUNGER
Manager, General Cement Products Corporation, Flint, Mich.

THE subject of "Developing a Business in Random Ashlar and Interior Units" is quite new to the cement products industry. The field is one that offers a large outlet for concrete products, and, if properly handled, it offers a market that will go far toward improving the quality and standing of our material in the eyes of the architect and the public.

The writer's experience in this field came about through an effort to enlarge his company's market and to find new uses for its product. The result was a complete revolution in his ideas of the whole subject of cement products.

New Conception of Concrete Units

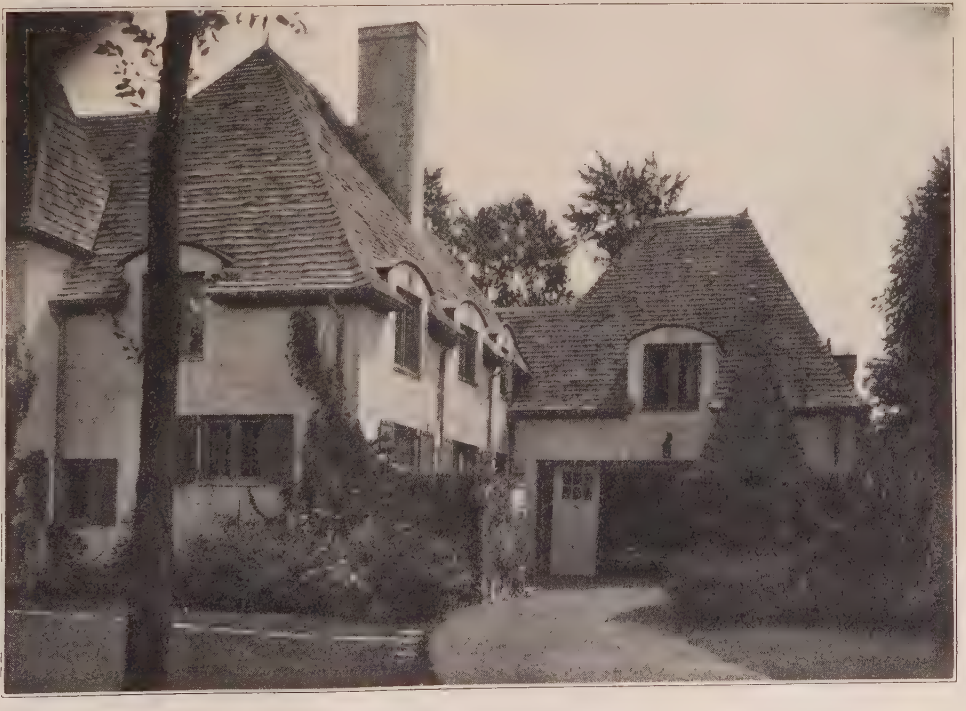
The old idea of a "cement" block was that of a cheap semi-finished building unit for use in basement walls and as a back-up for face brick, cut stone and other high priced materials. The new idea is that a concrete building unit may be a finished product, definitely taking its place in the minds of architects and the public as a sound, economical building material, suitable for use either in finished walls or as a back-up for the highest type of construction.

Our entry into the field was the result of a deliberately planned program, based on the belief that when properly made the product was suitable for use in an unplastered interior wall and as an exposed unit in exterior walls. In looking over the situation, we found that there were three principal difficulties to be overcome. First, the color of the wall was bad; second, the straight coursing did not give a pleasing effect; and third, the workmanship in laying up was far from satisfactory.

Getting Color Effects with Paint

Paint was the logical answer to the color question. Considerable experimental work was done in this connection. Sample units were painted and left out-of-doors to show the effect of weather. Two different brands of cement paint and one brand of oil paint were found to produce entirely satisfactory results. Later experience showed that a single spray coat of any of the three paints produced satisfactory results in the majority of cases.

Paper read before joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association, Milwaukee, Wis., February 23-24, 1931.



Architectural effect of painted cinder concrete units laid up in random ashlar. D. Allen Wright, architect

The monotony of straight coursing was overcome by making units 3⅝ in. high, two of which equaled one standard unit. These were used every third or fifth unit, with the location alternated in each course. Later, typical sections of actual randoms were designed. These required only three units not already produced as standard.

The obstacle most difficult to overcome was the poor quality of workmanship used in laying up exposed walls. To the average contractor and mason a concrete block is just a concrete block, regardless of whether it is to be covered or left exposed. The only satisfactory method of dealing with this situation thus far has been to insist on a sample wall being laid up before each job is started. In some instances it was necessary to hire an outside mason to prove that a satisfactory wall could be built.

Developing Market for Exposed Work

After satisfying ourselves that attractive exposed interior and exterior work could be done, the next step was to convince architects and owners that it was a good thing. The first question was "What do you have to offer?" We found a radical saving in cost over plastered jobs. Next we found that we could obtain artistic results in a natural way that looked exceedingly artificial when done in plaster.

Calls were made on architects with these two points in mind. Finally we found a job well suited to this type of interior finish. The architect wanted a much more complicated design than we had to offer, with the result that many units had to be cut on the job. This ran up the cost, but the effect achieved was so pleasing that we had no difficulty in finding other jobs that would use exactly what we had to offer in the way of designs.

Experience on these later jobs, using our stock sizes in typical sections, showed a decided saving in cost and also developed qualities whose existence we had not realized. During this period we found several jobs that were planned for face brick exteriors, which were easily swung to our material when the architect and owner saw the possibilities of concrete units in random designs.

Ten Rules to be Kept in Mind

The successful development of a business in random design and interior units is simple and can be accomplished as follows:

First, be sure that your material is true to size and shape, has clean edges and corners and a reasonably even texture.

Second, draw up several typical sections of designs that can be made with units you have in stock or can make.

Third, gather detailed information on the number of units of each size used in each section, and the number of sections per hundred square feet of wall. Get an estimate from a friendly and competent mason as to the cost of laying up.

Fourth, paint some sample units in various colors for exhibition to the architect and owner.

Fifth, make enough drawings of each typical section to cover the architects in your district, and enough for the masons on several jobs.

Sixth, call on the architects with the idea in mind that you are bringing them something that has proved good and is a step ahead in construction methods. Get out of his mind the idea of a "cement" block wall. Put your material on the same plane as face brick for exteriors and acoustical tile for interiors.

Seventh, let the architect take the credit for artistic accomplishment, but work with him on the mechanical side.

Eighth, work closely with the bidders on the contract, giving them estimates of quantities, based upon the number of units per hundred square feet of wall. Have a section of wall laid up at your plant to show what the unit will look like in the wall. Stress the fact that good workmanship costs little if any more than poor workmanship.

Ninth, sell the contractor on a given number of square feet of wall built to the chosen typical section. Itemize the number of units on each delivery, but charge for the number of square feet of material.

Tenth, watch the job closely when it starts, and if workmanship is not satisfactory, do whatever is necessary to bring it up to the proper standard. When you have a good job, show it to the other architects.

Points to be Guarded

Some points to be watched carefully are as follows:

Do not let the production of special units for this work interfere too much with the profitable production of your standard materials. The field is not large enough to keep your whole plant busy.

Do not let random design work interfere too much with the sale of your regular production.

Do not make too many odd sizes that will not sell for anything but random. Stick to sizes that can be sold on standard jobs.

Do not cast special shapes until you have a written purchase order and an approved detail to work to.

Do not cut the price of your standard units, but raise the price of those used in exposed work.

Above everything else, produce a high grade material. The greatest drawback to the concrete products industry, today, is variation of quality. Convince the architect and the owner that you are responsible and that he can always depend upon you, your service and your product.

If the principles set down here are followed, any concrete products company with a properly equipped plant, and which maintains a sufficiently aggressive sales policy, can profitably enter the field of random design for exposed exterior and interior walls.

Temperature of Cement on Dallas Quality-Controlled Concrete

The article "Quality of Concrete Held Uniform in Structures of Many Types," beginning on page 13 of the August issue of CONCRETE, states that, "Where mixing water was heated it was not heated above 180 deg. F., and cement was not used if its temperature was above 120 deg. F.

In amplification, Jean H. Knox, consultant on concrete and engineer of construction on the job and author of the article, writes that the temperature of cement was maximum at 120 deg. F. when other temperatures were high, and that under certain conditions it was desirable to order cement with temperatures up to 200 deg. F., and with excellent results obtained in concrete.

Metal Forms and Adjustable Shores Speed Erection and Removal

Use in Flat-Slab Concrete Building in Cincinnati—Can Remove Forms Without Disturbing Shores That Support Them—Methods Employed

IN the erection of a 3-story reinforced concrete warehouse of the flat-slab type of construction for the Great Atlantic & Pacific Tea Co., at Fredonia Avenue and the C. L. & N. Ry. tracks, in Cincinnati, metal form work has been employed throughout.

The general dimensions of the building are 105 by 400 ft. in plan. The total contact form area of the floor slabs and roof slab was about 120,000 sq. ft., or about 40,000 sq. ft. in each story.

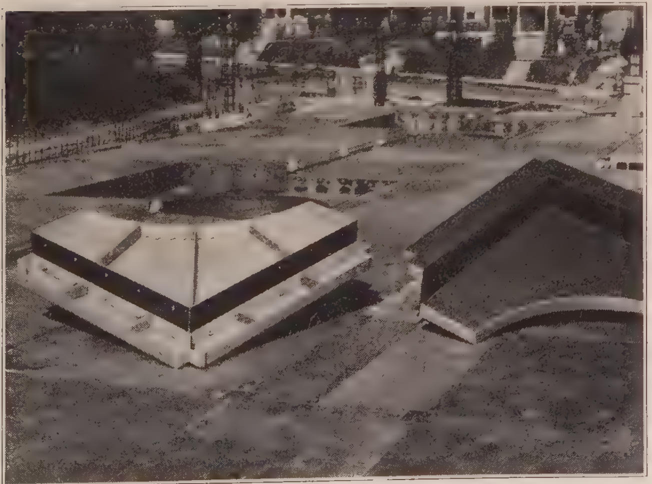
Make-Up of Metal Form Units

The standard floor forms employed consisted of metal pans 4 ft. square, supported by adjustable metal shores at each corner of the pan. The floor pans are made of sheet steel, backed and stiffened with angles and bars.

In addition to the standard floor pan (4 ft. square), adjustable pans were built 4 ft. wide and any length more or less than 4 ft., to fit the exact dimensions of the floor panel.

The outstanding feature of this type of form work is that the floor pans can be removed without disturbing the adjustable shores that support them. This feature is made possible from the fact that the heads of the shores are designed especially with this purpose in view. The actual supports for the floor pans are castings which pivot on the vertical flanges of the shore head. A wedge supports each casting or pan support while the pans are in position. When the wedge is removed the casting drops down and out of the way, permitting the pans to be lowered and removed, the shore meanwhile remaining in position.

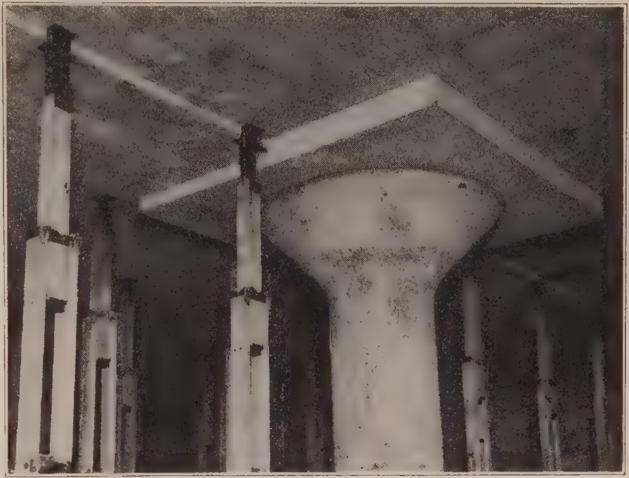
The feature just described permits the early removal of the floor pans, and their use elsewhere. As to the shores, they may all be left in place undisturbed, or alternate ones may be removed and used elsewhere when the concrete has attained sufficient strength to permit reduction in the number of shores.



Area of floor pans in place, and top and bottom view of forms for drop panel

Forms for Drop Panels

Forms for the drop panels in the Great Atlantic and Pacific warehouse were made up in 5 units, consisting of 4 quadrants or quarters, and a circular plate or ring to adjust the size of the opening for the column flare.



View of ceiling after removal of floor pans, with half of drop panel form in place

Laying Out the Work

The use of these metal form units, as might be expected, made it necessary to lay out the form work on paper. In a word, their use required the form work to be planned, with the consequent result that the work of form erection proceeded in an orderly manner and without waste of effort.

In making the form layout on the Atlantic and Pacific contract the usual procedure was followed. Each floor was laid out to scale, showing the exact dimensions of the contact areas. The form units were then laid out on the same floor plans, the 4 by 4-ft. floor units naturally being used as far as possible. To make up the odd dimensions, special adjustable units or floor pans were built 4 ft. wide and to the required length, whether more or less than 4 ft.

Units for the drop panels were likewise laid out with the view of utilizing standard sizes on hand to the greatest extent possible.

After all necessary details and dimensions were shown on the layout plans, the units were made up and delivered to the construction site, all special units having been identified with marks corresponding to marks shown on the plans.

Method of Erection

In beginning the erection of the form work, a small section of the floor was started, set up accurately and securely braced so as to obtain true alignment. Additional pans and shores were then mushroomed out from the aligned section until form work of the required area was in position.

Area of floor pans in place, with several pans raised up to show details

The actual setting of the floor pans was a simple procedure. When placing of a new row of pans was started the edge of the pan to be placed was pushed out 6 in. or more beyond the edge of the pan last in position, by two workmen on top of the floor. Two other workmen on the floor below each handled one shore, hooked up the head of the two shores with the outer corners of the pan and supported it while it was being pushed out still farther by the workmen above and finally dropped into position on the previously placed shores at the two inner corners. The two newly added shores were then adjusted to bring the pan to the proper level.

Additional pans added to the new row, of course, required only one additional shore, since three of the corners of the newly placed pan rested on shores already in position.

Openings for the Drop Panels

Because the standard floor pans are 4 ft. square, it was most convenient to leave openings for the drop panels 8 ft. square. In cases where the drop panel was less than 8 ft. square, the 8-ft. drops were placed, and supported on the 8 shore heads adjacent to the opening. The proper drop panel dimensions were obtained by metal boxes attached to the drop panel quadrants.

Removal of Forms

As previously stated in the description of the form units, the floor pans were removed by the simple process of removing the wedges that held the castings on the shore head in position. Removal of the wedges permitted the castings to be lowered on their pivots, swinging them downward and inward toward the shore. This left the way clear for the pans to be removed and the shores to be left in position.

When the removal of floor pans was started, the first pan was removed by means of blocks and wedges devised especially for this purpose. Succeeding pans readily dropped out when the wedges were removed and the pivots supporting castings were lowered.

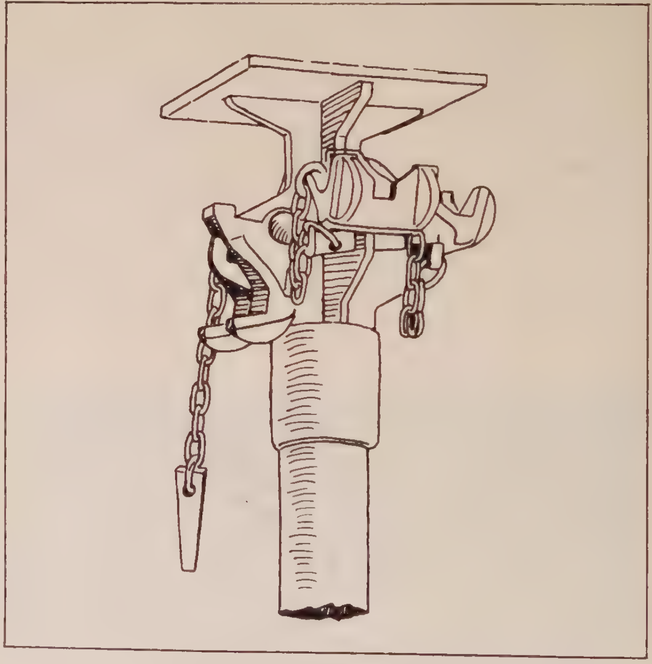
Crews of Four Men Each

Actual removal of the floor pans was accomplished by two men working on a temporary scaffold, which enabled them to work directly under the pan being removed. These two men then handed the released pan down to the two men on the floor below.

From this and the previous discussion it will be seen that a crew of four men is required, both for erection and removal; but any reasonable number of crews can be employed, each crew taking one or more floor bays as they go along. The crews each placed an average of about 4,500 sq. ft. per day of 8 hours on the Atlantic and Pacific contract, and since the schedule called for the removal and replacing of about 8,000 to 10,000 sq. ft. daily, four crews were generally employed.

Quantity of Forms Required

On the Atlantic and Pacific warehouse the concreting schedule was such that about 30,000 sq. ft. of floor pans were required, or about three-fourths of the form contact area of one floor.



Sketch detail of shore head

In buildings of smaller ground area it might be necessary to have as much as 1½ floors of forms on hand. The quantity of forms, however, depends entirely on the rate at which concrete is to be placed on the work.

In general, the minimum area of forms required is about $3\frac{1}{2}$ times the floor area to be concreted in a day. For instance, there is the area to be concreted on a certain day, assumed as Wednesday, for illustration. Ahead of this first area there must be a second area of about equal size, on which the steel reinforcement is being placed and wired on the same day. Still farther ahead, a third area of form work must be at least well under way by Wednesday evening, so that placing of steel can be started on that area on Thursday morning. Floor forms for the remainder of this third area can be brought forward from the area that was concreted on Tuesday, for inasmuch as all the shores are left in place the pans can be removed in two days under ordinarily favorable curing conditions.

General interior view. Pans removed without disturbing shores

The number of shores required is generally from 6 to 8 times the number required for one day's concreting. Under newly concreted floors there is, of course, one shore to every 16 sq. ft., but not all of these need be left in place for the full period during which shoring is maintained. When favorable curing conditions prevail, half the shores may be removed after 4 days, taking down alternate ones but leaving them staggered in adjacent rows. This leaves one shore to every 32 sq. ft. Again, about 7 days after concrete is placed, half the remaining shores may be removed, leaving one to every 64 sq. ft. as long as shores are needed.

Acknowledgments

The Ferro Concrete Construction Co., of Cincinnati, held the general contract on the Great Atlantic and Pacific Tea Co. warehouse. The metal form work was erected and removed by the H. W. Roos Co., also of Cincinnati. The H. W. Roos Co. is also the manufacturer and patent holder of the metal forms described here, but other contractors may obtain use of the forms on a leasing or rental basis.

Coming Conventions

October 5-10—Pacific Coast Building Officials' Conference, tenth annual meeting. Berkeley, Calif.

October 12-16—National Safety Council, 20th Annual Safety Congress and Exposition. Chicago, Illinois.

November 17-18—Portland Cement Association, annual meeting. Blackstone Hotel, Chicago, Ill.

January 9-15—American Road Builders Association, twenty-ninth annual convention and road show. Municipal Airport Building, Detroit, Mich.

January 25-26—National Ready-Mixed Concrete Association, second annual convention, William Penn Hotel, Pittsburgh, Pa.

January 27-29—National Sand and Gravel Association, sixteenth annual convention, William Penn Hotel, Pittsburgh, Pa.

March 1-4 — American Concrete Institute, twenty-eighth annual convention. Wardman Park Hotel, Washington, D. C.

~ PERSONALS ~

Herbert J. Gilkey, professor of civil engineering, University of Colorado, on September 1, was to assume his new duties as head of the department of theoretical and applied mechanics at Iowa State College, Ames, Iowa.

Prof. Gilkey will be remembered by readers of CONCRETE as the author of several articles on new developments in concrete aggregates.

Harry Kavnaugh, formerly structural engineer for the Chicago district office of the Portland Cement Association, has been appointed district sales manager by the Metal Forms Corp., Milwaukee, Wis.

Mr. Kavnaugh will establish an office at Kansas City, his territory including Kansas and a portion of Missouri.

W. F. Mackenzie, who was chief chemist of the Southwestern Portland Cement Company from 1921 to October, 1929, first at the El Paso, Texas, plant and later at the same company's plant at Osborn, Ohio, is now assistant to the general manager of the Pretoria Portland Cement Company, Ltd., of Johannesburg, Union of South Africa.

While in the United States Mr. Mackenzie was a member of the Technical Problems Committee of the Portland Cement Association and a member of Committee C-1 of the American Society for Testing Materials.

Chris Olsen, president and general manager of the Badger Concrete Company, died at his home at Oshkosh, Wis., on August 21, following a complication of diseases.

Profitable Manufacture of Concrete Building Units

Plant Records That Are Essential to Successful Operation—Details of Conducting Books—Example of Average Plant Presented

IX–Plant Record System

By FRED A. SAGER
Consulting Industrial Engineer

Plant records, as kept according to any of the various systems, are the pulse of successful products manufacture, and keeping his finger on the heartbeat of his business is no small part of the manufacturer's job.

Without presenting anything new and making no pretense of entering into a full discussion of the subject, Fred A. Sager tells what records he believes should be kept that the essential information may be disclosed.—The Editors.

FOR the moderate size products plant, as for any plant, the simplest record system that will furnish the necessary information should be adopted. The desired result should be gained with the least amount of clerical work. First there are the financial records or books of account, which are usually the ledger, cash book, journal, and possibly payroll records, payroll distribution, and perhaps other records of a financial nature.

Plant Records

Preceding these are the various plant records from which the entries are made into the financial records. The plant records have to do with the operations in the manufacturing plant, receipt of raw materials, and shipments of finished product and involve the use of certain records from outside businesses, such as delivery tickets receipted for raw materials and supplies coming into the plant and delivery tickets of the given plant for its finished product shipped out.

The financial records will consist of a ledger and a combined cash and journal book. The plant records will consist of a combined material and stock record and time book, later referred to as the Plant Records Book. In addition there will be kept in the files original delivery tickets and invoices for materials received and finished product shipped, and the daily plant report. All the necessary information as to the plant's operation and financial condition is contained in the three volumes referred to above.

Daily Report

Entries in the Plant Records Book are made from the daily plant report and from copies of delivery tickets for finished product shipped. The form of the daily plant report will be first considered. A suggested form is shown as Diagram 11, suitable for an 8½ by 11-in. sheet. It contains first the payroll of the plant men, total time and wages, as well as the payroll distribution in whatever detail may be desired.

Provision is made on the form for manufacture, yarding, or delivery from kilns to storage yard, raw materials which will include time of men when unloading, repairs including time on machine or plant repairs of maintenance, and a column for miscellaneous work. Entries under the last three heads should be accompanied by suitable explanations under "Remarks," in order that the charges may be made to the proper account in the Plant Records Book. The hours' time in the first column are posted to the Payroll record and the dollars in the line "Total" are posted to the Payroll Distribution—two sections in the Plant Records Book—such postings being noted by check mark on the Daily Plant Report.

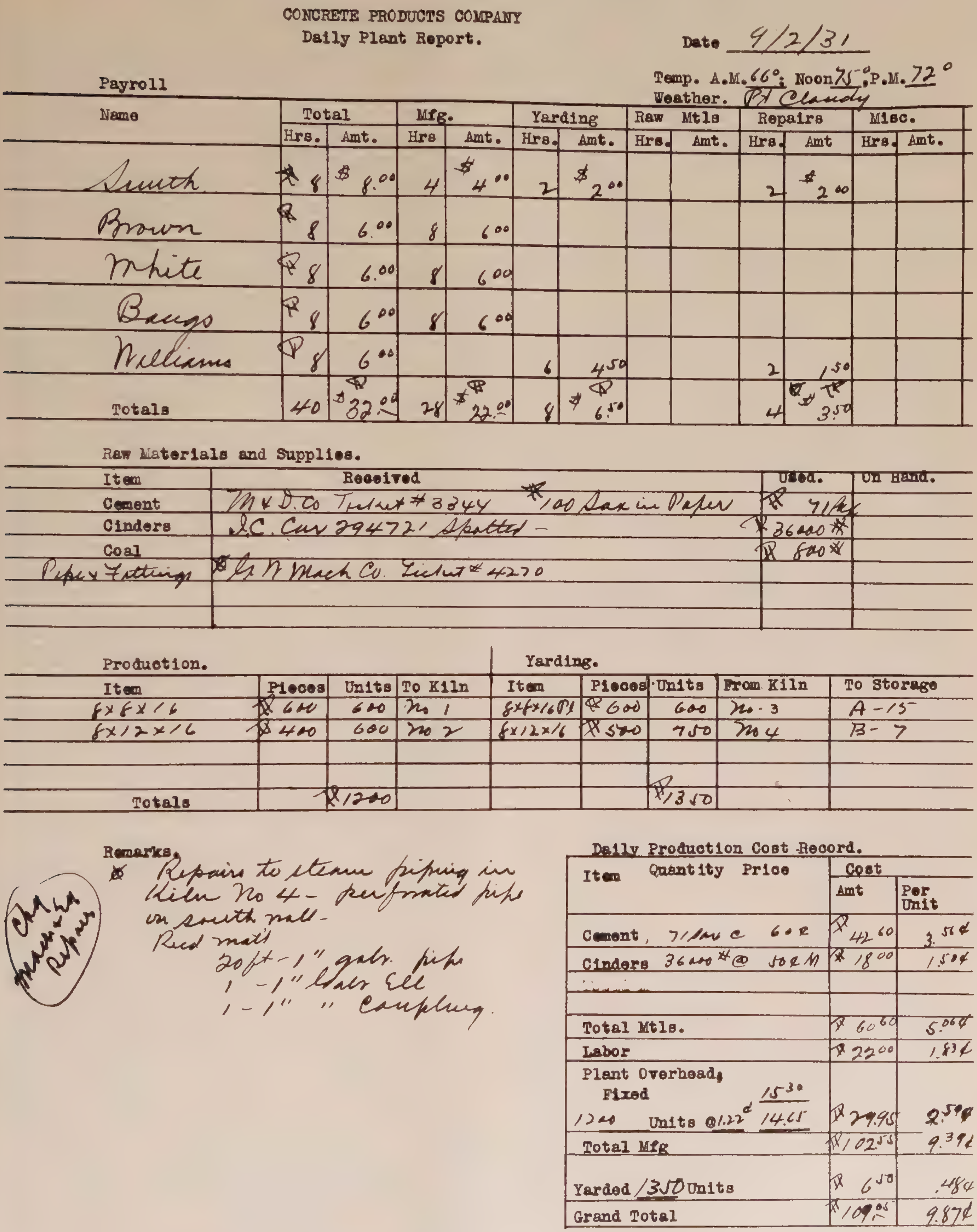
Raw Materials Record

Under the heading Raw Materials and Supplies provision is made for showing receipt and use of these materials. In the case of the load of cement received by truck, the entry shows the ticket number, name of company furnishing it, etc. All tickets for material received should be turned in with the Daily Report for filing in the office records. The number of sacks of cement used in manufacture is entered in the proper column. The last column, showing the amount on hand, may or may not be used daily, as desired. If not used daily it should be filled in on the last day of each month in order to keep a check on the raw materials inventory, as will be considered later. Under Cinders, the receipt of a carload is noted, but no quantities are noted. Assuming that the car is unloaded the following day, that report will say, "I. C. Car 294721—Unloaded—110,000 lbs.," and from that item the amount will be posted to the Plant Records Book. On account of demurrage it is important that the records show date of arrival and of unloading the cars received.

The item of coal used will, in most plants, be an estimated amount, but it will do no harm to enter such amounts, and if not at first, after a little practice such estimates will be fairly accurate. The item of pipe and fittings is not posted to the Plant Records Book, but the entry in the Daily Plant Report serves as a check on the invoice when received.

Production Account

Under Production is entered the day's output expressed in number of block of each kind, and the equivalent in 8-in. units, and the same for the product yarded during the day. There is also included space to note the location



CONCRETE PRODUCTS COMPANY
Daily Plant Report.

Date 9/2/31

Temp. A.M. 66°; Noon 75°; P.M. 72°
Weather. Pt Cloudy

Payroll

Name	Total		Mfg.		Yarding		Raw Mtls		Repairs		Misc.	
	Hrs.	Amt.	Hrs	Amt.	Hrs.	Amt.	Hrs.	Amt.	Hrs.	Amt	Hrs.	Amt.
Smith	8	$8.00	4	$4.00	2	$2.00			2	$2.00		
Brown	8	6.00	8	6.00								
White	8	6.00	8	6.00								
Baugs	8	6.00	8	6.00								
Williams	8	6.00			6	4.50			2	1.50		
Totals	40	$32.00	28	$22.00	8	$6.50			4	$3.50		

Raw Materials and Supplies.

Item	Received	Used.	On Hand.
Cement	M & D. Co Ticket # 3344 100 Sax in Paper	71 Sax	
Cinders	I.C. Car 294721 Spotted –	36000#	
Coal		800#	
Pipe & Fittings	G N Mach Co. Ticket # 4270		

Production.				Yarding.				
Item	Pieces	Units	To Kiln	Item	Pieces	Units	From Kiln	To Storage
8×8×16	600	600	No 1	8×8×16 PI	600	600	No. 3	A – 15
8×12×16	400	600	No 2	8×12×16	500	750	No 4	B – 7
Totals		1200				1350		

Remarks.

Repairs to steam piping in Kiln No 4 – perforated pipe on south wall –
Req'd mat'l
20 ft – 1" galv. pipe
1 – 1" Galv Ell
1 – 1" " Coupling.

Chg Mach'y & Repairs

Daily Production Cost Record.

Item Quantity Price	Cost Amt	Per Unit
Cement, 71 Sax @ 60¢	42.60	3.56¢
Cinders 36000# @ 50¢ M	18.00	1.50¢
Total Mtls.	60.60	5.06¢
Labor	22.00	1.83¢
Plant Overhead, Fixed 15.30 1200 Units @ 1.22¢ 14.65	29.95	2.50¢
Total Mfg	102.55	9.39¢
Yarded 1350 Units	6.50	.48¢
Grand Total	109.05	9.87¢

Diagram 11. Suggested form for daily plant report

of the product in the kilns from the machines, and in the storage yard from the kilns.

Storage Yard Map

So far as the storage yard is concerned, it would be advantageous to prepare a map or chart of the yard, mark the storage areas for 8-in. units A, B, etc., and subdivide these areas into A1, A2, etc., B1, B2, and so on for the entire stock. This done and the Daily Plant Record filled out, nothing further need be done in the matter, as the plant superintendent ordinarily has the state of curing of the various stockpiles in the small plant fairly well in mind.

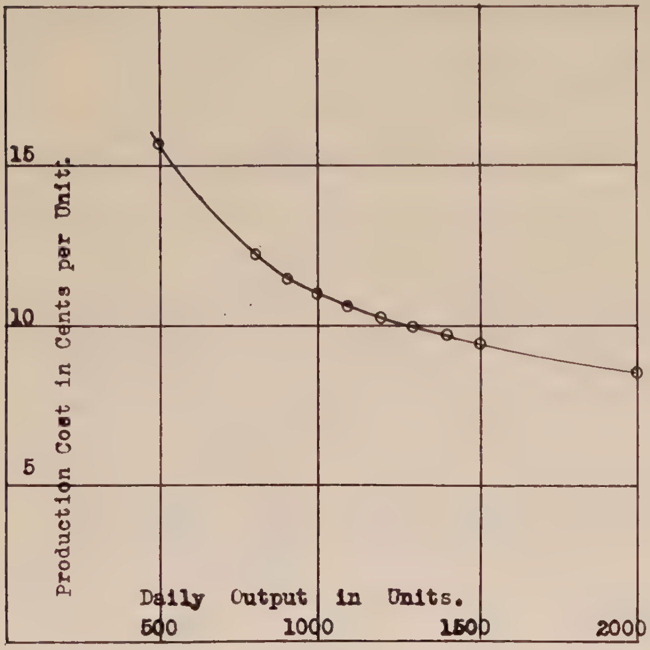


Diagram 12. Variation in cost per unit with variation in daily output

Daily Production Cost Record

The use of the daily production cost record is, of course, optional. As shown on the form it is easily made and serves the purpose of keeping the manager aware of his day's results. He must be provided with the items under the heading "Price," that is, the unit costs of cement and cinders; the labor cost he has from the first section of the report; and the overhead costs must be given him. These are derived from the office records and as shown are divided into two parts, the fixed charge for each working day of the year being the proportion such as taxes, rent or interest on the plant, telephone, fire insurance, and such expenses as are independent of the plant's operation on any particular day, and the other expenses such as fuel, electric power, water, machinery, maintenance, etc., which will vary with the amount of work done or units made in any given day. Based on the last month's or last year's operation such units may be derived and used for these estimates in the given month.

In line with the upper part of the report the cost of manufacture is separated from the cost of yarding, showing a cost of 9.39 cents per unit for manufacture, product delivered to the kilns, and a cost of .48 cents for yarding, a total cost of 9.87 cents per equivalent 8-in. unit for the day's work. It is believed that any capable plant manager, if making out such reports daily, will be alive to the necessity of so ordering his routine of production, maintenance work and repairs as to keep the daily costs reasonable. In case of unusual conditions he should accompany the report with proper explanations.

Unit Production Cost

In this connection it may be of interest to represent in graphic form the relation between the daily production and cost per unit for a given plant. On the basis of the above payroll for five men and the material costs and plant overhead, the cost per unit produced varies from nearly 16 cents per unit with a daily production of 500 units per day to about 8.5 cents with a production of 2,000 units per day, as shown in Diagram 12. It is evident that the production must be kept between 1,000 and 1,500 units in the interests of reasonable costs.

Determining Overhead Costs

For reference the following table shows the method of determining the overhead costs used above, based on a plant cost of $28,200, made up of land, $10,000; buildings, $6,200, and equipment, $12,000. With production of 340,000 units the annual overhead expenses are estimated as follows:

Item	Annual Cost		
Direct Plant Overhead:	Total	Fixed	Variable
Rent (interest)	$1,962	$1,962	
Electric power and light	796		$ 796
Fuel	480	80	400
Water	216	16	200
Plant repair	180	80	100
Machinery repair	1,200	100	1,100
Sundry plant expense	240	200	40
Taxes	420	420	
Fire insurance	300	300	
Liability insurance	192		192
Depreciation	1,500	300	1,200
General Expense:			
Office salaries[1]	720	720	
Office expense[1]	120	20	100
Telephone	240	210	30
Misc. general expense[1]	180	180	
Totals	$8,746	$4,588	$4,158

Fixed cost per day for 300 days, $15.30.

Variable cost per unit for 340,000 units, 1.22 cents.

In using this method, any plant should go over its cost records and separate as reasonably as possible the variable costs from the fixed costs in determining the figures to use in such estimates. With reasonably uniform operating conditions, it is probably best to use the last month's experience, for the given month. It is further understood that these estimates do not enter into the final costs for the given month, but they are made up from the actual expense as later determined. As a matter of interest, however, the daily production cost record can well be posted in the Plant Records Book.

The following article will conclude the consideration of plant records and accounts.

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[1] Portions of these expenses assigned to Operation of Manufacturing Plant.

Short-Cuts in Structural Design

New Chart Provides Ready Means of Determining Pressure Against Foundation Walls When Height and Character of Earth Fill Are Known

V—Earth Pressure Against Foundation Walls

By JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College

MOST engineers will admit that the earth load on foundations and retaining walls is appreciable. As to how it should be figured, much difference of opinion exists.

The writer's attention was first called to the seriousness of this problem while acting as superintendent of construction on a mid-western school project. The boiler room floor was nine feet below grade. Cracks soon developed in the concrete foundation wall. After figuring the approximate stresses it was evident that no account had been taken of the earth pressure due to the 9-ft. fill against the wall.

It is not necessary to get into any controversy as to the proper methods of figuring earth pressure. Any individual who has played with beach sand along lake or ocean knows that moisture content alone has a tremendous effect. Varying from dry sand to excessively wet sand, almost any condition of repose may be obtained. The moisture content of any fill usually varies. So the writer is personally not inclined to favor some of the more elaborate earth pressure theories.

The Fluid Pressure Theory

Many engineers favor the so-called "fluid pressure" theory for walls of reasonable height. This method is recommended in the A. R. E. A. manual, which is an indication of its conservative results. This method reduces the earth to terms of an equivalent fluid in which the intensity of pressure varies directly with the depth of fill.

In the case of the pure fluid, we have the following results:

The intensity of pressure at any depth is found by the expression—

$$p = w\,h$$

Where p = intensity of pressure, lb. per sq. ft.

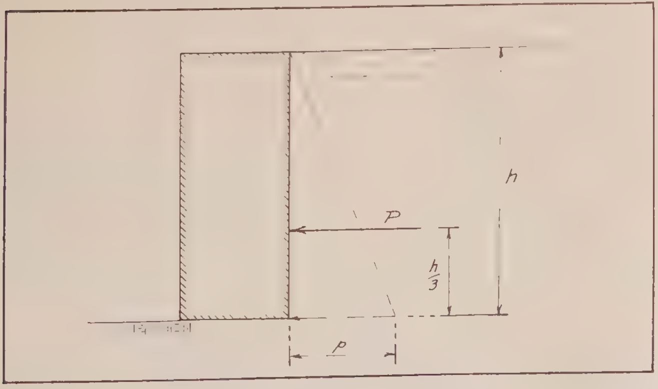


Figure 1

w = unit weight of the fluid, lb. per cu. ft.

h = depth of liquid at point in question, in ft.

The total pressure above the section for a unit length of wall of 1 ft. is given by the expression—

$$P = \frac{w\,h^2}{2}$$

Where P = total pressure, in lb.

This is but the volume of the pressure wedge against the 1-ft. length of wall.

The point of application of the resultant pressure (P) is taken through the center of gravity of the pressure wedge, $h/3$ from the bottom.

The overturning moment, due to the pressure P, is then—

$$M = \frac{P\,h}{3} = \frac{w\,h^3}{6}$$

Where M = moment about the base section, in ft.-lb.

Equivalent Fluid Weight of Fill

The weight (w') of a fluid equivalent to the given fill is given by the expression—

$$w' = w\,\frac{1 - \sin \phi}{1 + \sin \phi}$$

Where w = weight of fill, in lb. per cu. ft.

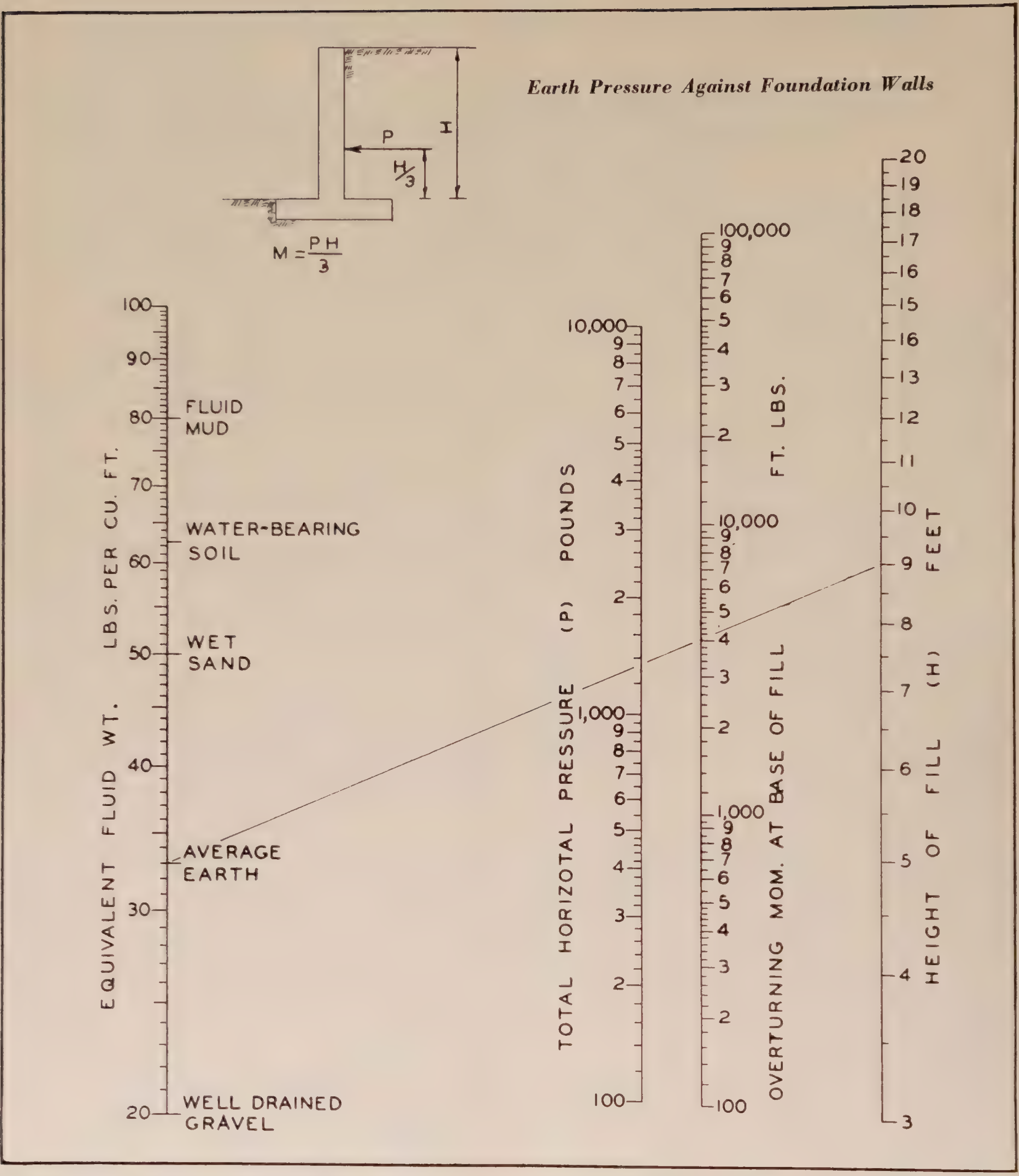
ϕ = angle of repose of fill.

The *Handbook of Building Construction*, by Hool and Johnson, recommends the following average values:

Fill Material	Equivalent Fluid Weight $w' = w\,\frac{1 - \sin \phi}{1 + \sin \phi}$
Well drained gravel	20 lb. per cu. ft.
Average earth	33
Wet sand	50
Water-bearing soil	62.5
Fluid mud	80

The chart has been designed to give the total pressure (P) and the overturning moment (M) on the basis of the above method. The left-hand scale is calibrated for values of the equivalent fluid weight. In addition, the values recommended by Hool and Johnson are located on this scale. The right-hand scale gives the fill heights. A straight line from the fill material to the fill height gives, on the central scales the values of (P) and (M). I have shown an isopleth on the chart for a nine-foot fill of average earth obtaining

P = 1,350 lbs.
M = 4,010 foot pounds.



Earth Pressure Against Foundation Walls

By formula—

$$P = \frac{w' h^2}{2} = \frac{33 \times 9^2}{2} = 1{,}336 \text{ lbs.}$$

$$M = \frac{w' h^3}{6} = \frac{33 \times 9^3}{6} = 4{,}008 \text{ ft. lbs.}$$

Movies Show Uses of Concrete and Making of Cement

The important uses of concrete and the manufacture of cement are the subjects of two one-reel motion picture films now available from the United States Bureau of Mines, Department of Commerce.

The first, entitled, "Construction That Endures," depicts the numerous uses of concrete. Animated drawings are used in the early scenes of the film to show the composition of concrete. Views include those of the Panama Canal, park structures in use, roads and streets, airports, farm and railroad uses, buildings, and art objects.

Animated drawings and ingenious photographs have been used in the second film, "From Mountain to Cement Sack," to make the various processes clear. A dotted map shows the locations of the country's 150 plants.

Concrete Pavement Crosses Peat Bog on Pile Foundation

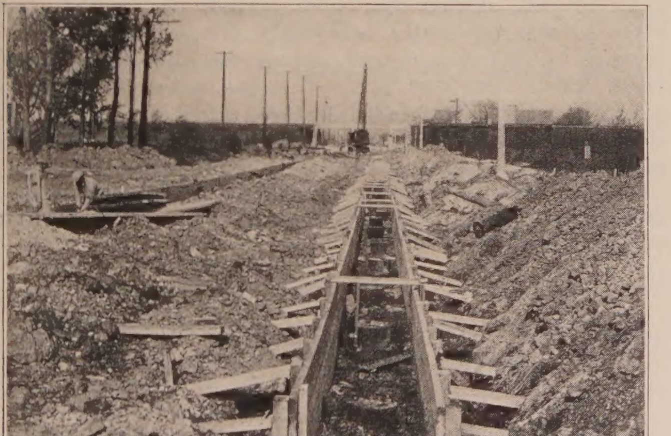
Badly Settled Section Removed as Part of Widening Project—Road Slab Heavily Reinforced

The Illinois Department of Highways has built a 40-ft. concrete pavement across a peat bog and supported it on three lines of piling. The section is about 600 ft. long and includes an important intersection with another 40-ft. concrete pavement. A line of piling was set under each edge and along the center of the 40-ft. slab and the piling were capped by concrete beams. The pavement was built as a flat slab supported by these beams.

The road over the peat bog was first paved in 1926, when the rest of the roadway north and south of that point was paved. Settlement of the pavement laid on the peat so warped and cracked the slabs that, when it was decided to widen the pavement to 40 ft., plans were drawn and a contract was let for removal of that portion of the pavement over the peat and replacement with a section which would not settle.

Bog 12 Feet Thick

Test holes disclosed as much as 6 ft. of solid macadam that had been placed in the road in an attempt to keep it passable before the original pavement was laid. In general there was, beneath this macadam or gravel, 2 ft. of peat, 15 in. of sand and clay, 4 ft. of peat, followed by a mixture of sand and peat, making the total depth of the peat bog about 12 ft. Below this there was a layer of gravel about 17 ft. thick. A test pile driven at the center of the intersection of the two highways drove easily to a depth of 26 ft. below grade and was then driven solid at a depth of 36½ ft. A pile at the other end of the job drove solid at a depth of 34 ft.

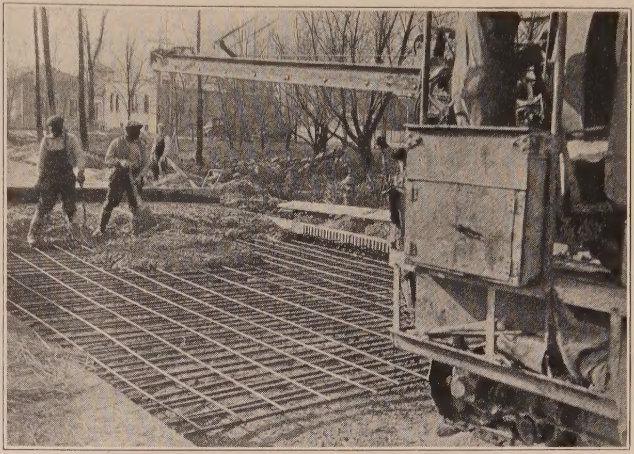


Beams 24 in. deep by 30 in. wide were cast as caps for the piling. The piling project 9 in. into the caps

Construction Details

Creosoted piling ranging in length from 32 to 42 ft. were driven to a specified 18-ton bearing. The specified minimum diameter was 8 in. at the tip, 12 in. at a point 4 ft. from the butt, and maximum butt diameter of 20 in. The piles were spaced 10 ft. apart under the edge of the slab and 5 ft. under the center. A total of 106 42-ft. piling were required in the intersection and 224 from 32 to 42 ft. long in the balance of the job. The contractor received 65 cents per ft. for the piling and 45 cents per ft. for driving.

The piles were capped by concrete beams 2 ft. deep and 2½ ft. wide, reinforced with four ¾-in. round bars in both top and bottom. Tops of piles extend 9 in. into the beams.



The roadway slabs were reinforced with 1-in. square bars on 6-in. centers transversely, top and bottom, and ½-in. square bars on 12-in. centers longitudinally

The slab laid on these beams was 13¼ in. deep at the sides and 17¼ in. at the middle, reinforced with 1-in. square bars spaced 6 in. center to center transversely, and ½-in. square bars 12 in. center to center longitudinally. It was laid with the clay subgrade as a foundation.

Protection from Cold Weather

As concreting was started late in the 1930 season, when there was danger of freezing temperatures, the mixer was equipped with a gasoline tank and air compressor, and a torch was placed in the drum. With air temperatures of 35 deg. F., concrete had a temperature of 70 deg. F. when discharged from the drum. The mixing time was 3 minutes. The concrete was covered immediately with burlap and straw to retain the heat.

Acknowledgments

The work was under the general supervision of G. N. Lamb, district engineer for the Illinois Department of Highways, and K. D. Avedisian was in charge as resident engineer. John Mackler & Company, Inc., of Chicago Heights, Illinois, was the contractor.

Reinforcing Institute Semi-Annual Meeting in September

The semi-annual meeting of the Concrete Reinforcing Steel Institute was to be held at Buckwood Inn, Shawnee-on-Delaware, Pa., September 28 to 30.

One of the sessions was to include a conference under the auspices of the U. S. Department of Commerce on proposed further standardization in areas of spiral rods.

HOW TO DO IT

✦ **Questions and Answers** ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Commercial Cinders for Concrete and Concrete Units

Where is the best place to look for commercial cinders for concrete and concrete block, and what are the specification requirements for such cinders?—S. H. O., Bellefontaine, O.

Commercial cinders for concrete work usually are obtained from power plants or other places where high pressure steam boilers are used. The purpose is that of getting cinders that are well-burned and have the least practicable amount of ashes. In other words, ordinary household cinders are not suitable unless given some further treatment, as a concern in New York is now doing.

The requirements for commercial cinders, as established by the Underwriters' Laboratories, are given on page 42 of the July (1930) issue of CONCRETE. Here you will see that, among other things, the quantity of combustible material may now be 35 per cent, by weight. Whether or not cinders from any particular source comply with the Underwriters' Laboratories requirements can only be determined by submitting a sample lot to a testing laboratory.

Cracks in Walls of Concrete Masonry Units

I have had trouble with cracks that appear in walls of concrete units made by us. These cracks occur mainly above grade. They appear in some buildings, while in others we have no trouble. Can you suggest the cause and the remedy?—S. W. B., Norfolk, Va.

It has been definitely determined in a number of such cases that the cause of the cracking was the drying out of the concrete unit in the wall. The block as laid in the wall was still green and had not gone through the process of shrinkage which usually occurs during the 30 days following manufacture. Such a unit contains moisture and for that reason is slightly larger than a dry block. Later, under the effect of wind, warmth and moisture, the block is dried out and naturally the unit is slightly reduced in size. When this occurs in a great number of units placed in a wall, it is inevitable that cracks will develop either in the mortar bond or in the unit itself, depending on whether the mortar is stronger or weaker than the unit.

The fact that your experience indicates that it is the block above the foundation or basement walls that show these cracks emphasizes the probability that this is the cause. The basement walls, of course, being in contact with the ground are more likely to retain moisture, whereas those in the wall, exposed to the weather, dry out.

Several products manufacturers have met this problem by installing drying systems which dry out the block after it has passed the moisture curing period. A description of how one manufacturer of concrete brick did this will be found on page 20 of the March (1928) issue of CONCRETE. Of course if you keep more block in stock in outside storage for a time long enough to dry it out completely, such an artificial drying system will not be necessary. However, holding the block in outside storage for this length of time naturally means that more storage yard capacity must be supplied and that considerable investment will be tied up in block in storage.

A still more effective method of causing concrete units to take their normal shrinkage quickly, in one or two days, is to subject them to high pressure steam curing. This method, which involves a somewhat expensive installation, is discussed in an article on page 43 of the February (1931) issue of CONCRETE.

In Florida, during the boom period, the trouble you refer to was especially noticeable. Extensive investigations as to the cause showed that almost without exception these cracks were due to the fact that green block were placed in the wall and that as these dried out the cracks developed. It would appear that this is the only reason why cracks such as you describe should form, provided, of course, that the concrete unit walls rest on stable foundations and settling of the foundation is not a factor to be considered.

Recommended Building Regulations Issued by the N. B. F. U.

Where can I get a copy of the building code published by the underwriters?—G. A. R., Dixon, Ill.

Very likely the publication to which you refer is the Building Code recommended by the National Board of Fire Underwriters, 85 John Street, New York.

Copies of the fifth edition, which is a complete revision issued in the present year, may be obtained from the N. B. F. U.

Construction of Griffith Design Charts

I am finding much use for the 38 charts for the design of reinforced concrete, as prepared by Prof. James R. Griffith.

Please tell me something about the principles underlying the construction of charts of this type.—M. S. H., Ithaca, N. Y.

The construction of these and other so-called nomographic charts is explained in the body of an article by Prof. Griffith in the March (1928) issue of CONCRETE, pages 13 to 16.

Organizations

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 624 Fisher Building, Detroit, Mich.
Twenty-eighth annual convention, March 1-4, Wardman Park Hotel, Washington, D. C.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.
Twenty-ninth annual convention and road show, January 9-15, Municipal Airport building, Detroit, Mich.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

American Standards Association; P. G. Agnew, Secretary, 29 West 39th St., New York City.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Canadian Engineering Standards Association; 46 Elgin St., Ottawa, Ontario.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; R. W. Crum, Engineer-Director, B and 21st Sts., Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Building, Washington, D. C.
Second annual convention, January 25-26, William Penn Hotel, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.
Sixteenth annual convention, January 27-29, William Penn Hotel, Pittsburgh, Pa.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.
Annual meeting, November 17-18, Blackstone Hotel, Chicago, Ill.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

New Books and Pamphlets

Estimating and Cost-Keeping

Estimating and Cost-Keeping for Concrete Structures. By A. E. Wynn, B. Sc., Assoc. M. A. S. C. E. Published by Concrete Publications, Limited, London, England. Price $6.

The author of this book is well known as a successful contractor and as an authority on construction methods in reinforced concrete work. In this book he has endeavored to show how cost information can be obtained and be applied in preparing a bid. The book deals mainly with reinforced concrete construction. The author treats his subject in a practical manner and shows how a system of estimating and cost-keeping may be built up. Untried theoretical methods are passed over, and only those systems which the author has found practicable are included.

Handbook Gives Useful Information

Useful and up-to-date information on concrete, both plain and reinforced, is contained in the new Handbook of Concrete Construction just issued by the Universal Atlas Cement Co., Chicago, Illinois.

The book is written from a practical rather than a technical standpoint. It is a pocket manual of general information on concrete, applying particularly to smaller structures.

Beginning with a discussion on concrete as a construction material, the first chapter is devoted to making good concrete. It traces step by step methods of mixing, placing and curing concrete on the average job. This includes consideration of materials, equipment and labor and a clear presentation of the water-cement ratio method. In the second chapter the basic rules of reinforcing concrete are briefly presented. There follows, in the remaining three chapters, discussion of forms for concrete, construction of small concrete structures and simple rules for estimating quantities and costs.

The book has 208 pages, is well illustrated, and contains 48 tables on quantities, sizes, loads, and so on. It has a complete index.

Reinforcement in Concrete Pavements

Reinforcing Steel in Concrete Pavements, the title of an address delivered by Clifford Older, consulting highway engineer, before the seventh annual meeting of the Concrete Reinforcing Steel Institute on March 17, 1931, has been reprinted by the Institute in the form of a 12-page pamphlet. Numerous detailed drawings have been included.

The text and illustrations include the subjects of cross-sections of Illinois concrete roads, center joints, improper center joints, tie bars at center joints, expansion joint problems, transverse cracks, slab reinforcement, marginal bars, and transverse contraction joints.

Copies of the pamphlet may be obtained from the Concrete Reinforcing Steel Institute, Tribune Tower, Chicago, Ill.

New Rubber Expansion Joint for Concrete Highway Slabs

Result of Two Years' Experiments—Rubber Filler Expands and Contracts With Opening and Closing of Joint

A NEW rubber expansion joint for use in concrete road construction has just been placed on the market by the B. F. Goodrich Rubber Co. through its retail division, Goodrich Silvertown, Inc., Akron, Ohio.

As one of the illustrations indicates, the opening for the expansion joint is made by the use of a wood form which is later to be removed. This can also be constructed with steel forms, of course, to put the finishing operations over the top. Any time after the concrete has reached its initial set the forms can be removed.

The lower section, not exceeding one-third of the joint, is filled with asphalt. After this operation is completed, the rubber expansion joint is compressed into place. The rubber expansion joint is cemented under pressure into the proper position, which is slightly below the surface of the concrete slab. The amount of compression of the rubber should be equal to the maximum contraction that would be expected in the concrete slab. By this arrangement when the concrete slab has reached its maximum contraction the rubber simply expands to its normal size. Also, due to the porosity of the material, as the slab expands from its normal condition the expansion will be taken up by the rubber. The rubber will not protrude above the pavement.

The advantages of this joint are stated by the manufacturers to be as follows:

1. The joint expands and contracts as the slab contracts and expands respectively.

2. By the use of the rubber cement the joint is waterproof as far as the surface water is concerned.

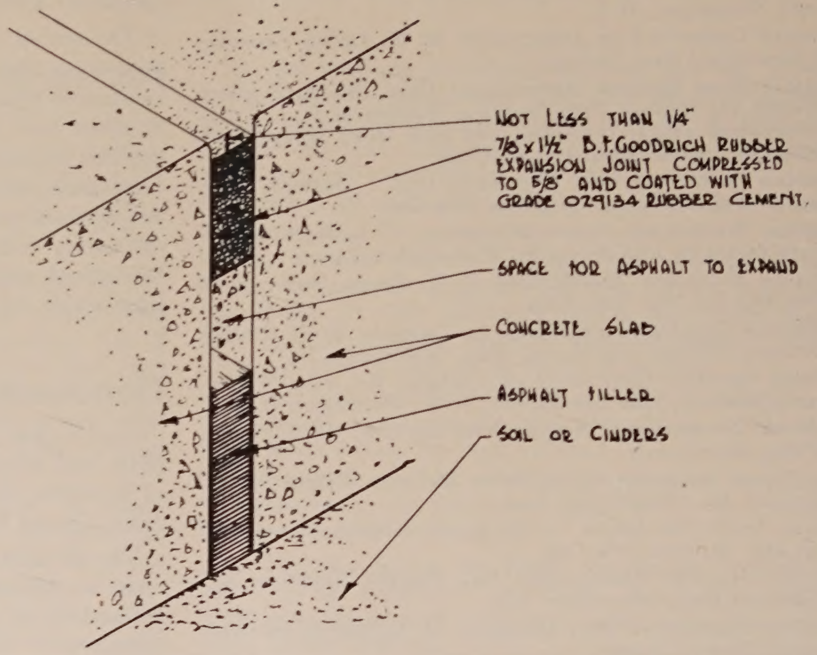
3. It does not protrude above the concrete slab during the maximum expansion of the concrete slab in summer months.

4. It will remain in position during the entire life of the joint and will not need replacement.

5. The rubber expansion joint can be designed for any degree of porosity to allow any limit of elasticity so as to properly take care of the expected expansion and contraction.

The manufacturers have been experimenting with this rubber expansion joint for approximately two years. Several thousand feet of the material are in use in various service stations in different parts of the United States. The earliest installations, which are now a year and a half old, show the rubber expansion joint in apparently as good a condition as when it was first installed. The exact location where the joints may be seen in service will be supplied to inquirers.

Highway engineers in several states have consented to test the material out in some of their concrete pavements, in order to give the joints actual highway service tests.

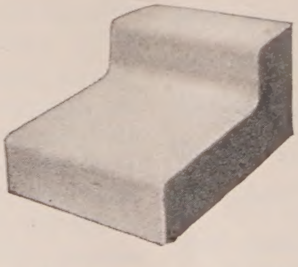

NOT LESS THAN 1/4"
7/8" x 1 1/2" B.F.GOODRICH RUBBER EXPANSION JOINT COMPRESSED TO 5/8" AND COATED WITH GRADE 029134 RUBBER CEMENT.
SPACE FOR ASPHALT TO EXPAND
CONCRETE SLAB
ASPHALT FILLER
SOIL OR CINDERS

New Equipment

Curb-Gutter Block for Driveways Is Products Specialty

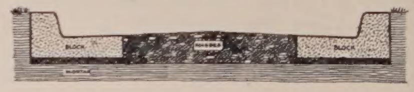
On the market and sold in the East for two years, American curb-gutter block are now being taken on as a products specialty in other parts of the country.

These block are portable units made on a special patented machine designed for the purpose, in a one-piece section combining both gutter and curb. They are assembled into continuous curb-gutters for private driveways and roadways, park and garden walks, lawns and other landscaping uses. Made in straight, curved and end sections, they may be laid to meet any curve or angle requirement.



Each block is one foot long, forming a gutter one foot wide with a 5-in. curb, and weighs approximately 70 lbs. The block are laid in a 1-in. bed of cement mortar and the joints are filled with mortar.

The curb-gutter block machine produces two units per minute and may be mounted under any standard power tamper. Changing tamper shoes is all that is necessary. Machines are being leased by the American Curb-Gutter Block Co., Inc., New York City, which is also assigning exclusive territory.



Industrial Literature

Harbord "Plycrete" Booklet

The clean, even face of concrete placed in *Harbord "Plycrete"* forms is one of the four outstanding advantages of the use of this type of panel, according to the *Harbor Plywood Corporation*, Chicago.

This feature and others are presented in a booklet on Harbord "Plycrete," and illustrations show jobs on which the material has been used.